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AT END OF
VOLUME.

PREFACE.

By the time this volume reaches the reader's hand the present European War will have lasted exactly a year and a half without (at the time of writing) any victory of military decisiveness having been obtained on either side apart from Great Britain's mastery of the seas. The past twelve months have naturally been a time of much embarrassment to those engaged in the manufacture of photographic materials and apparatus. Lack of raw material, deficiencies in transport and shortage of labour are difficulties which makers have had and still have to experience and therefore, it is a matter for congratulation that the disturbance of conditions so far as concerns the production of plates and papers, has been as small as it has. So far as concerns apparatus, there are few factories which have not been engaged to their utmost in the manufacture of good for the national services of a kind appropriate to their facilities.

In these circumstances it would have been foolish to have attempted the customary task of reviewing the latest new introductions on the English market in the way of photographic appliances. In its place the reader will find, on pages 507 to 556 a survey of the resources of Great Britain in the production of the requisites for photography. A reading of this article will show that already in several important respects we are rendering ourselves independent of German supplies.

GEORGE F. BROWN

Editor

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ERRATUM.—On page 368, under Drying Prints Flat, "downwards" (line 10) should read "upwards."

PRACTICAL NOTES ON PRINTING PROCESSES.

BY THE EDITOR.

For some years past there has been comparatively little done in the way of originating new photographic printing processes. We stand to-day very much where we were about ten years ago, when the introduction of self-toning paper added about the last newcomer to the methods which are available for the printing from negatives on commercial materials. Nevertheless, the photographic worker of to-day has at his command a range of processes which far exceeds that at disposal in the early days of the dry-plate. At that time one process (albumenised paper) was used to the exclusion almost of the other two methods, platinum and carbon, then upon the market. The years since then have witnessed the introduction of bromide and gaslight papers and of printing-out papers prepared with gelatine or collodion emulsion. They have also witnessed the more widespread use of the platinum and carbon printing processes and, further, an offshoot of the carbon process (ozobrome) with special facilities recommending it particularly to the amateur worker. Amid all this development of new methods the old albumen process which formerly held universal sway has completely disappeared, and I believe at the present time albumenised paper is quite unobtainable. Although, as I have said, the last ten years have witnessed no radical departures, yet there have been many improvements in the details of using various printing papers. Of these I shall endeavour to deal particularly in this article, but I seek here also to treat the subject of printing processes in a way which will make the matter of service even to the least experienced among my readers. Therefore I would beg for the patience of more advanced photographers whenever I may lay out some elementary facts for the benefit of those whose knowledge of printing processes is of the slightest.

In this article I shall deal with the processes best known by the popular names of gaslight, bromide, P.O.P., C.C. (collodio-chloride), self-toning, platinum, and carbon, with the variation of the last-named—viz., ozobrome.

First, to distinguish very briefly these various processes. Both gaslight and bromide papers are preparations which, like dry-plates,

show no visible image on exposure to light; the image is brought out by a developer of much the same kind as that used for plates. "Gaslight" paper is the least sensitive variety of bromide paper, with the result that it *can* be developed by artificial light or even by weak daylight, whereas bromide paper requires to be handled by yellow light. Further than this, gaslight paper (or at any rate the chief makes) gives a much more brilliant or plucky print than does bromide paper.

The three printing papers next on my list, P.O.P., C.C., and self-toning, are akin to bromide and gaslight paper only in so far that the sensitive coating consists of silver compounds. These compounds, however, are quite different from those used in the papers requiring development. P.O.P., C.C., and self-toning papers require to be printed fully out under the negative until the picture is, in fact, considerably darker than is required in the finished print. They are finished off by one or other of several toning processes according to the colour desired in the final print. Self-toning papers are so named for the reason that the chemicals active in producing toning are contained in the coating upon the paper itself. It should be added that development papers (gaslight and bromide) are prepared with gelatine as the vehicle of the sensitive silver compound. In the case of print-out papers, however, both gelatine and collodion are used. P.O.P., as that term is used in this country, signifies a print-out paper with gelatine as the vehicle of the silver salt. C.C. signifies a similar class of paper, but with collodion as the basis of the sensitive coating. Self-toning papers are most of them prepared with collodion, but there are one or two which carry a gelatine emulsion.

The last two processes on my list are quite distinct from the foregoing and from each other. In platinum paper the sensitive material is a compound of iron, but the final image consists of platinum metal formed by the interaction of platinum compounds in the paper with the differently constituted iron compounds which are formed when the paper is exposed to light under the negative. By variations in the coating mixtures the platinum print can be produced of either a neutral black or warm sepia colour. As regards exposure, platinum paper occupies a position between the development and print-out processes: it is exposed until a faint, semi-visible image of the subject can be seen. It is, however, a process which requires daylight, or very strong artificial light, such as an ordinary or a mercury arc lamp, for the making of prints.

The carbon process is similarly a daylight method, but one which is essentially different from any other process on my list. Unlike other processes, the material of the image is fixed at the start. It is that of the pigment which the maker of the "carbon tissue" selects. The tissue consists of this pigment in admixture with gelatine coated on to the paper. It is rendered sensitive to light by treatment with a solution of potassium bichromate. The effect of light upon gelatine containing bichromate is for the gelatine to become insoluble, and thus to hold the pigment tenaciously when the exposed tissue is put in hot water. The parts which receive a

lesser action of light are dissolved away in proportion, as the light has not acted on them. This is a crude outline of the process. I deal with it more adequately in the chapter on carbon which follows.

Lastly, we shall consider the ozobrome process, or "evening carbon," as it is called for the reason that it dispenses with daylight in the making of a carbon print, utilising in place of the ordinary daylight exposure of the tissue a bromide print from the negative. This print, by contact action with the carbon tissue, in the presence of a special solution, produces a result which, broadly, is the equivalent of that which the tissue undergoes on exposure to light under the negative in the ordinary way.

PRINTING PROCESSES COMPARED

So much for the distinctive character of the various processes as regards the principles on which they depend or the kind of manipulation adopted in conjunction with them. Users, however, are more concerned with a comparison of these various methods, which comparison may be properly considered under four heads, viz. :- (1) Kind of result; (2) permanence; (3) convenience; (4) uniformity, by which latter I mean the capacity of the process for turning out a lot of prints as like each other as possible.

We can summarise the characteristics of the processes in these respects in a very few words. The kind of result produced by gaslight and bromide papers is a print of black "colour," the colour varying very slightly with the developer which is used and ranging from a neutral black to a bluish black. Certain papers are specially made for yielding a warm black colour. Both bromide and gaslight prints are amenable to various processes of after-toning by which the black colour may be converted into brown, blue, green, or red.

The characteristic result of P.O.P. is a print of purplish colour when the print is toned by the most usual method—namely, a bath of gold and sulphocyanide. This paper can likewise be toned and fixed at the same time in a "combined" bath, when the tone is usually more towards brown. Other tones can be obtained by the use of single baths (that is, those which do not fix at the same time) made up according to various formulæ.

The special characteristic of C.C., or collodio chloride paper, is the extremely fine, warm black tone which it affords by a special duplex treatment—namely, first, a brief toning in a gold bath followed by a second toning in a bath containing platinum. In addition to this, collodio chloride paper lends itself exceedingly well to the production of a series of warm tones up to red chalk by means of platinum toning baths (chiefly) of various formulæ.

Self-toning papers vary considerably in the result which they give on treatment by the standard method of simply fixing in a bath of hypo. Most makes yield a warm brown tone. With some, the result is a very good imitation of the tone produced by gold-sulphocyanide toning of P.O.P. In the case of those papers with a collodion emulsion very fine warm black tones are obtained by the use of a bath containing platinum. This is not an advisable process

for gelatine papers, which are not well adapted for toning with the platinum, the results very often proving impermanent.

The quality of a platinum print as regards colour has already been mentioned. I suppose there is no process which is the equal of platinum in affording a print of fine engraving black tone. The platinum print is unique also in another respect, namely, in the natural character of its surface. There is no emulsion coating on the paper, the surface is that of the natural paper itself, and as for other reasons the highest quality of paper requires to be used for the platinum process, a finished platinum print possesses a beauty which is without a rival.

Carbon has also certain unique features. It excels any process in the wide range of colours in which prints can be produced, for, as I have already said, the colour of the print is fixed by the pigment selected in making the tissue. The effect of the final print, however, is not limited to the selection of the tissue, for in the carbon process the image is transferred to a second support, which latter (the transfer paper) may be of any tint or colour which is thought suitable. The process thus provides the means of an extensive range of effects by the use of a particular colour of tissue in conjunction with a transfer paper of appropriate tint.

In the matter of permanence it is a little difficult to make a strictly true comparison. Beyond question the results by the carbon and platinum processes are the most lasting of any form of photographic print. The other processes are always relegated to a secondary class as regards permanence, and, broadly speaking, with reason. But it must be borne in mind that when we talk about permanence we must keep before us not merely the theoretical possibilities of a process, but the actual accomplishment when prints are made in quantity and very often without the most scrupulous care in manipulation. I suppose one could take any printing process and claim a full permanence for it on the strength of the existence of prints unimpaired after having been made five, ten or twenty years ago, but that is not what should be understood by permanence in the practical sense. We require to consider what reasonable probability there is of a print by a given process lasting for a full term of years when made in company with others by the methods which one customarily follows, that is, without extra precautionary measures. It is from that point of view that the silver processes—development and print out papers—are undoubtedly the inferior of the two *de luxe* processes—carbon and platinum. In other words, it is difficult by improper working to make a carbon or a platinum print which is liable speedily to fade or to develop markings which disfigure it. On the other hand, careless manipulation of any silver paper will inevitably result in impermanence of some sort or another. Comparing the silver papers among themselves, undoubtedly those of the development class are the premier as regards permanence. An ordinary bromide or gaslight print, properly fixed and washed, is of a high degree of permanence in the ordinary conditions in which prints are kept in albums or frames. The liability to change, as the result of exposure to fumes from gas,

etc., is still less if the print is sulphide-toned. Next in order of permanence (among silver prints) I should place those on P.O.P. toned in a single bath, and next in order I should class together those on self-toning papers and on collodio chloride. The last named is certainly the paper which requires most knowledge of its susceptibility in order to obtain prints which are reasonably permanent and free from tendency to develop stains or spots. The reader will gather this from the notes in a later paragraph.

When we talk about convenience, there can be no doubt that papers of the development type head the list, as witness the enormous degree of popularity of these papers among both professional and amateur users. For the amateur a paper which can be handled solely by artificial light must score heavily over one which can be printed only by daylight. Moreover, the operation of development is one which an amateur can much more readily master as compared with the practice and skill required to attain success in the use of toning baths on print out papers.

And the same thing applies in the matter of uniformity. Here, again, a development paper, whether bromide or gaslight, is one which makes it a much easier matter to produce a series of a dozen or score of prints exactly like each other than those in silver paper of the print out type. The carbon and platinum processes, on the other hand, are fully the equal of development papers in this respect.

GASLIGHT PRINTING

The average sensitiveness of 'gaslight' papers makes them suitable for exposure either by daylight or by some fairly strong artificial light. The speed of the various commercial papers varies considerably. With most of them the exposure to outdoor daylight is inconveniently brief. With an average negative it is rarely more than a second or two and will often be much less than that. In the latter event it is possible to make the exposure sufficiently quickly. In any case, it is not advisable to use such a strength of light that the exposure is less than five seconds, for the reason that it is then not easy to make a series of exposures all of the same time as necessary for getting a batch of prints of equal quality. When exposing to daylight, the best plan is to place the printing frame back in a room so that it receives much weaker light, or to cover the front of the frame with one or more thicknesses of tissue paper.

On the other hand, exposures to some sources of artificial light are inconveniently long if the negative is of anything like excessive density. For comfortable exposures on most gaslight papers, one wants a good incandescent gas burner or an electric metallic-filament lamp of about 32 c.p. One or two grades of gaslight paper are very much slower than the average. For example, the Anaco "Professional" grade of "Cyko" paper is about one-sixth the sensitiveness of an average gaslight, and therefore calls for a strong light in printing. With such papers, small negatives can be placed quite close to the light, say, about four inches away, but for larger negatives, this plan results in uneven illumination.

and it is necessary to get a bigger volume of light by employing more lamps or gas burners. It is worth noting here that incandescent gas burners vary considerably in power, that is to say, in actinic effect. One gas burner which I can recommend as very efficient, not only for contact printing on gaslight paper, but also for enlarging (on bromide), is the "Howellite."

HANDLING GASLIGHT PAPER.

Although gaslight paper *can* be handled with safety in weak day or artificial light, yet it must be borne in mind that its sensitiveness is such that it can easily be fogged. The two chief causes of this fogging action in ordinary circumstances are: (1) Exposure of the paper to direct light, that is, one coming straight through a window on to the paper, or straight from an electric lamp or gas burner on to the paper. It is necessary for safety that the paper should be handled behind some screen which shields it from the direct rays. The light loses a great deal of its effect by being reflected from the walls of a room, and the reflected light is comparatively safe while, at the same time, permitting ample illumination for comfortable working. In other words, when working in daylight, draw down the semi-transparent blinds in a room and handle the paper with your back to the light when loading it into frames or developing. In the case of artificial light, a more convenient plan is to erect some good-sized screen, such as a drawing-board or large sheet of cardboard, to place the light on one side of it and to carry out loading of the frames and development of the prints on the other. (2) The precautions just mentioned ensure only comparative safety, comparative, that is, in the sense that the paper will not be fogged as the result of the amount of exposure which it gets in handling it with customary precautions. The precautions will not mean safety if the paper is allowed to be about exposed even to this diffused light. It is a good plan to take the supply of paper from a packet, place it in a box with a hinged lid, which can be readily shut the moment the supply for a given number of frames has been taken out. A leather dispatch case is a very convenient receptacle for this purpose.

I have written so far as though a weak light was the only kind of illumination in which to handle gaslight papers. It ought to be made clear that there is no reason whatever why one should not handle these papers in bright yellow light. In point of fact, such an illumination is really preferable, for one feels perfectly sure that papers can come to no harm even if left about accidentally for some time. A very bright yellow light can be used, such as one gets by placing a single thickness of canary fabric in the dark-room lamp. In fact, the cream-coloured light afforded by one sheet of opal glass in the dark-room lamp provides a safe and most agreeable illumination for most gaslight papers. Where a second electric lamp or gas burner can be employed in the dark-room solely for the safe-light, the best plan is to arrange the lamp so that the illumination comes vertically downwards on the working bench. This affords much more comfortable working when making prints,

the appearance of which has to be judged entirely upon the surface. If a lamp of this kind is not available, it is a very easy matter to extemporise one simply by making a bottomless box, covering the lower opening with canary or orange fabric, placing inside an electric lamp or inverted incandescent burner, and covering the upper opening with more orange fabric or with black material, such as silesia lining.

GASLIGHT PAPERS.

There is a very wide range among gaslight papers, not only as regards speed, but more especially as regards the contrast or vigour of the prints. Some gaslight papers are made for exceedingly flat negatives, whilst others yield a degree of vigour which is not very much more than that of a bromide paper. Most makers designate these more soft-working papers as "special" or "portrait," but here again one maker's "special" or "portrait" will vary considerably from another's. The beginner in gaslight printing is advised to select a negative which fairly represents the average result which he obtains, and to try one or two papers before choosing one for regular use. If he is constantly changing about from one paper to another he will never get any results worth looking at.

Then again, papers differ also in regard to the way in which they develop. All the earlier gaslight papers, on being placed in the developer, came up to full intensity in a second or two; longer development only fogged them. During the last year or two other papers have come upon the market which develop in much the same leisurely manner as a bromide, requiring about two to four minutes for complete development. When one is working in a dark-room this type of paper, I am inclined to think, is preferable, but for the user who is working under the conditions in which he is screening his developing bench from direct strong light the quick-developing type of paper is certainly better.

FINDING THE CORRECT EXPOSURE WITH GASLIGHT PAPER.

The crux of successful gaslight printing is in the correct exposure of the paper. Very little experience will tell the worker about what exposure to give to a given source of light which is fairly constant, such as gas or electric. Daylight with its continual variation makes it very difficult to gauge exposure correctly.

A very useful aid to correct exposure is a special form of printing frame sold by Messrs. Marion, the feature of which is the provision of four separate shutters by means of which a different exposure can be given to four portions of the print. This is a time-saving device, because we can start exposure with all four shutters open, and shut down one after another, thus securing four different exposures in much less time than by using four separate small test pieces of paper. In such trials about the best system to go on is to double the exposure each time. For example, if one judges that the paper would be about correctly exposed with 10 seconds exposure we give a series starting from 5 and going up to 40. To do this, all four shutters of the frame are pulled up and an exposure

of 5 seconds given. At the end of this 5 seconds, shutter ~~is~~ pushed down and a further exposure of 5 seconds given. This means that strip No 2 (as also Nos 3 and 4) has received 10 seconds; shutter No 2 is in turn pushed down at the end of this second 5 seconds, and a further exposure given of 10 seconds, which makes 20 seconds for strip No 3, at the end of this 10 seconds, shutter No 3 is pushed down and exposure continued for a further 20 seconds. In other words the general rule is: Expose under all four shutters for, say, half the time which you think will be correct, expose for a similar period with shutters 2, 3, and 4 open, then for double the time with shutters 3 and 4 open, and finally for four times the exposure of No 1 with the fourth shutter open. Such preliminary trials can be carried out very quickly at a single exposure by making a semi-transparent graduated screen out of some thicknesses of oiled paper. This screen is laid between the negative and the sensitive paper so that part of the negative is covered by one thickness, part by two, and part by three thicknesses. To use such a screen it is necessary first to find out how many times one, two, or three thicknesses of the translucent paper prolong the exposure which is correct without a screen at all. This can be found once and for all and the numbers marked on the respective sections of the screen. Then when trying a new negative we give an exposure (with the screen in position) several times that which is judged to be the correct time without any screen. If our guess is reasonably correct one section will come out as a perfect print. The time of the test exposure is then divided by the number marked on the screen and subsequent prints made by exposure for this time after having removed the screen. Although this method calls for a little trouble at the start it is one which saves a good deal of time in working from negatives of different densities. In this country one maker (Messrs. G. & A. Smith) issue with each packet of their "Nocrona" gaslight paper a numbered test screen for the purpose.

GASLIGHT DEVELOPERS

Although almost any non-staining developer can be used for gaslight papers that which gives the best average result is metol hydroquinone. I doubt if it is possible to improve upon the original M Q formula issued for Velox paper which is as follows:—

Metol	8 grs
Hydroquinone	30 grs
Soda sulphite, cryt	$\frac{1}{2}$ oz
Soda carbonate, cryst	$\frac{1}{2}$ oz
Potass bromide, 10 per cent solution	20 minims
Water	10 ozs

This single solution developer if kept in small bottles ~~filled to the neck~~, preserves its qualities for, at any rate, months. Other developers, such as Azol and amidol yield quite satisfactory results on gaslight papers. They usually require a little extra potassium bromide added to them, in the way of one drop or so of 10 per cent potassium bromide solution to every 4 ozs of developer.

DEVELOPING GASLIGHT PRINTS.

In gaslight printing it is an entirely wrong method to attempt to make good any errors of exposure by tinkering with the developer. The exposure requires to be adjusted to the developer, once we have got the latter in proper working condition. By that, I mean securing the developer of non-logging quality in respect to the particular paper. This condition is secured by adding, if necessary, a very little (only a drop or so) of bromide solution. If it is found that the print does not come up, as regards detail or depth in the developer, it is clear that insufficient exposure has been given. But if it comes up of flat appearance and quickly darkens all over, it may be the result either of over exposure or of a developer insufficiently restrained with bromide, or the cause may be both of these things acting at the same time. Thus, in making a test exposure, as I have suggested above you feel your way at once, since you are able to distinguish between the effect of over exposure and of unsuitable developer. If all the test exposure strips are veiled and fogged, it is clear that the developer is at fault and requires cautious addition of a little bromide solution. The quantity of the latter varies more being required in summer than in winter, for a warm developer will fog where one of the same composition at a lower temperature would give brilliant prints. One or two test strips having shown that the developer has been brought into proper working order correct exposure is a simple matter.

Addition of too much bromide is shown by the defective colour of the prints they then tend to a brownish colour in place of the clear bluish black which they should have with M Q developer. The colour too falls off after a considerable number of prints have been developed in one lot of solution. In controlling the developer in this respect prints should be examined (after fixing) in white light it is difficult to judge of falling off of colour when prints are being handled by yellow light.

FIXING GASLIGHT PRINTS

Gaslight papers vary in regard to the kind of fixing bath which is required. For some papers a plain fixing bath of strength about 3 or 4 ozs of hypo in 20 ozs of water is quite all right. But most papers are better fixed in a bath of the acid type. If fixed in plain hypo solution they are liable to stain. The maker's instructions will indicate the kind of bath to be used whether plain or acid. Formulæ for acid baths being often rather complex let me give a formula here which is simple and cannot be improved upon. It is —

Hypo	3 to 4 ozs
Potash metabisulphite	$\frac{1}{2}$ oz
Water	20 ozs

This bath will keep perfectly clear, and is just as good as the more complicated mixtures made up with sulphite of soda and acetic or sulphuric acid.

But whatever kind of bath is used, it is most essential that

each print, as it is placed in it, should be fully immersed; that is, pressed down under the surface of the liquid. Never use the fingers for doing this, but, instead, a print paddle, such as is sold of ebonite by the Kodak Company, or of rubber in a wooden handle by Messrs. Butcher. You thus avoid all contact of the hands with the hypo bath until, say, twenty or thirty prints have reached the fixer. Then, you can give them all a turn over, drawing the bottom print to the top until all have been changed round in this way.

It is a moot point whether prints should be rinsed or washed between development and fixing. With most gaslight papers, there is no necessity to do this: indeed, some are liable to develop stains if given more than the briefest rinse after development. The only object of rinsing is to keep the hypo bath in a non-stained condition for a longer time. This applies more especially to a fixing-bath of plain hypo. The hypo-metabisulphite bath will remain colourless almost indefinitely, even if there is no rinsing of the developed prints.

After fixing, prints are given the customary wash. If washing is properly done, half an hour is ample time, but that means that prints are freely and separately exposed to a stream of water in a washer, or are transferred singly from one dish of clean water to another, then back again to clean water, and so on through six or seven changes. Simply placing prints in a clotted mass in a dish and letting the tap run into the latter will not wash effectively, however long they remain under this treatment.

BROMIDE PRINTING.

The first essential to good bromide printing is proper illumination of the dark-room. Bromide paper, of course, must be handled in yellow or orange light. Since bromide papers are now made of sensitiveness which is pretty much on a par with that of a slow negative plate, a very bright yellow light such as that through one thickness of canary fabric is perhaps hardly safe enough. Two thicknesses of canary fabric, or one of orange fabric will be safe. Whatever you do, don't attempt to work bromide paper in the deep ruby light which is given by most dark-room lamps. Have a bright orange light and plenty of it, best arranged to fall straight down on the working bench, as already described under "Gaslight Printing."

TELLING THE FILM SIDE OF DEVELOPMENT PAPERS.

This applies to both gaslight and bromide papers; but less to the former, since it is usually easy to recognise the coated side of gaslight papers in the brighter light in which they are handled. But when handling bromide paper it is not so easy. There is no difficulty with glossy or semi-glossy papers, but with the papers of fine matt or rough matt surface it is often difficult to tell which is the coated side. There are several ways of making sure. First, note the way in which the paper is packed. Makers' methods vary, but a common plan is for the sheets to be packed

in pairs, film to film, with a sheet of tissue between each pair; that is, between two uncoated surfaces. Other makers place all the sheets in a packet with the coated sides facing the same way, with the exception of one which they lay coated side down upon the outer sheet. At any rate, make yourself familiar with the maker's plan of packing: you can follow it as a reasonably safe guide.

Many papers will readily curl when laid down on the hand, the coated side assuming a convex shape. Also, the coated side, if one corner of a sheet of paper be touched with the moistened finger, will be felt as sticky, owing to the softening of the gelatine coating.

A further method of telling the coated side is to go by the burred edge of the sheet, which usually stands up slightly from the film side.

Still another method is to hold the paper bent in the form of an arch between the eye and the dark room light. The line of light along the outer top of the arch or loop will indicate the nature of the surface. Glossy or semi-matt paper is instantly recognised by its appearance. In the case of matt paper the emulsion side appears perfectly smooth and even, whilst, in comparison with it, the paper side has a distinct sheen. In the case of rough papers the emulsion side shows scarcely a trace of any line of light.

PRINTING APPLIANCES FOR DEVELOPMENT PAPERS.

You can make bromide or gaslight printing a most tedious business by sticking to the same kind of printing frame which is

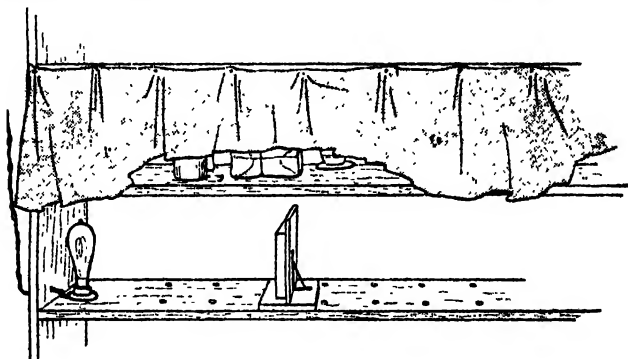


FIG. 1.

Printing Board, showing Frame Carriage. Curtain is drawn cut away. It reaches to lower shelf so as to enclose the printing light.

used for P.O.P.—I mean the ordinary pattern with loose hinged back. Every time the frame is loaded the back has to be 'ound.

fixed in place, and the two springs pressed down, all of which is quite unnecessary for bromide printing. I know of only one printing frame specially made for bromide work, but any frame can be quickly adapted by making a one piece back and hinging it to the frame, so that it has only to be turned over to come in position on the paper. For small prints, say up to half-plate size, there is really no necessity to have springs on the frame, the pressure of the hand on the back of the frame suffices during the brief exposure. For larger frames, or if exposures have to be lengthy, then, with a rigid back, one spring will answer the purpose.

Have a printing board on which the frame can be placed at various distances from the source of light. I give a drawing here from a former "Albumen" showing an arrangement which can be placed on any convenient shelf. The source of light—gas, oil, or electric—is placed at one end, and a series of pairs of holes bored at, say, 6 ins. from the light (the first pair) and at succeeding distances of 6 ins. These holes take two pegs projecting from the under side of a loose carriage on which the printing frame can be laid.

In bromide work a most valuable means of making the best of defective negatives is to print at a greater or lesser distance from the light. An average position is, say, 24 ins., but by going as near as 6 ins. or as far away as 48 or 60 ins. a great deal can be done to improve the result from hard or flat negatives respectively, printing the former close to the light and the latter further away. The distances, of course, depend upon the power of the source of light. Usually a 16 c.p. carbon filament lamp, an open flat-flame gas burner, or a bijou incandescent burner are quite powerful enough, whilst among oil lamps there is plenty of choice.

PRINTING MACHINES FOR BROMIDE AND GASLIGHT PAPERS

Of late years the work of printing on development papers has been rendered immensely more rapid by the introduction of printing machines or boxes. Their advantage consists first, in the fact that the light is boxed in, and therefore exposure of the paper does not interfere with development work at the same time in the dark-room. Second, there is no fiddling about in the way of placing negative and paper in a frame. The negative is simply laid on a glass bed, the paper placed on it, and a hinged pressure board brought down. In most patterns of machine this pressure board, by its one action, presses the paper against the negative and at the same time switches on an electric light or brings a gas or oil burner into operation. There are a score or more of these printing boxes upon the market, all on much the same principle, but varying in details. Some are constructed chiefly for the rapid production of a large number of prints from one negative, and are therefore suited chiefly for professional or commercial use. The amateur worker will be best served by a type of machine into which the negative is simply laid in a carrier frame and some simple form of stop adjusted over it, thereby fixing the position into which the sheet of paper is to be laid.

printer of this simple type may be purchased for about \$1, and is a convenience which no amateur worker who has had experience of it will readily forego.

These printers are most compactly and conveniently made when electric light is used in them, but almost as efficient models can be had for use with gas or even with an oil lamp. The drawback to a printing box is that the strength of light falling upon the negative cannot be adjusted simply by altering the distance between the two. In place of that, one or more thicknesses of ground glass or tissue paper, bound *passee partout* fashion between a couple of glass plates, can be inserted within the printing box. With many printers the speed of bromide paper requires the light to be damped down in this way in any case. For gaslight printing usually one requires to use a naked light, and even then at times one finds exposures inconveniently long. A metallic-filament lamp in place of one with carbon filaments will help matters very considerably, but if a paper is so slow or a negative so dense that exposures run to more than 20 or 30 seconds the box printer is better replaced by one or two printing frames arranged round the source of light. Some printers are fitted with a latch by which the pressure board is held down during the period of exposure instead of requiring to be pressed down by the hand, but even then the loss of time in getting off a series of prints from one negative is not avoided.

DEVELOPERS FOR BROMIDE PAPERS.

Although any non-staining developer can be used for bromide paper—and some workers have even written extolling pyro-soda—yet the three chief developers for bromide work are amidol, metol, and metol-hydroquinone. I put aside for the moment ferrous oxalate, which is undoubtedly superior to any of these in the results which it gives, but involves, I am afraid, too much additional trouble for the modern worker to employ it regularly. There is no need here to multiply formulæ: the makers' instructions can be followed. As regards metol-hydroquinone, the formula already given for gaslight papers serves excellently for bromide if diluted with water in the proportion of one part of the stock single solution, given on an earlier page, with one to two parts of water. An excellent amidol formula is that given for the Wellington papers, namely:—

Amidol	50 grs.
Potass. bromide	10 grs.
Soda sulphite, cryst.....	650 grs.
Water	20 ozs.

In order to secure the really fine black prints which amidol is capable of yielding it is necessary to use freshly made developer. The amidol is best dissolved at the time of use, taking care that it is fully dissolved, and the sulphite also should not be kept in solution for longer than three days.

For the metol developer a very good formula is that for the Barnett

A. --Metal	400 grs.
Soda sulphite, cryst	8 ozs.
Potass. bromide	50 grs.
Water	80 ozs.
B. Potass. carbonate	2 ozs.
Water	20 ozs.

To make the working developer, three parts of A. are mixed with one part of B. Both stock solutions can be kept for a very considerable time.

I give here also formula for the ferrous oxalate developer because it is one the results by which fully justify the additional operations which are necessary in the way of treatment of the prints in a series of acid baths before fixing. The developer is made from the two stock solutions.

A. -- Potass. oxalate, neutral	5 ozs.
Hot water	20 ozs.
Potass. bromide	10 grs.
B Ferrous sulphate	5 ozs.
Sulphuric acid	30 minims.
Water, warm	20 ozs.

The oxalate solution keeps indefinitely. The sulphate of iron solution does not keep very well and should be thrown away as soon as it is seen that the pure green colour of the solution is taking on a yellowish tinge. A few fragments of fine iron wire kept in the solution will improve its keeping qualities.

To make the developer, 4 ozs. of A. are measured out and 1 oz. of B. added to it, not *vice versa*. The mixture forms a deep orange-red solution which should be perfectly clear and bright. If it is muddy, it is a sign that the iron solution has deteriorated, or possibly that a bad sample of oxalate was used for solution A.

This developer differs from all others in requiring that the prints should be passed through one or two baths of :- Acetic acid (glacial), 1 dr.; water, 20 ozs., before being fixed. The developed print must go straight into the acid bath, not into water should remain there for about two minutes a longer time will not harm it then go through a second acetic bath for the same time, and then be washed for a quarter of an hour or so in several changes, before being fixed.

While the ferrous oxalate developer is certainly the best in skilled hands for the production of black prints, I would not advise the amateur worker, to use it when his object is to prepare sepia prints by the sulphide-toning process, or, indeed, when any toning process is to be used which requires potassium ferricyanide. Unless the iron of the developer is perfectly washed out from the prints, the use of a ferricyanide toning bath is very liable to produce deep blue stains of Prussian blue.

DEVELOPMENT OF BROMIDE PRINTS.

Except for very large prints (enlargements) there is no necessity to soak the paper in water before development. The exception to

this rule is the paper of very rough surface, such as is now made by almost every manufacturer. It is better to let these papers have two or three minutes' soaking in plain water before pouring on the developer.

The chief point which I want to emphasise in regard to development of bromide prints is that it should be thorough, by which I mean that the exposure should be such that the paper can be kept for, at least, three or four minutes in the developer without the print becoming too dark. The thing to aim at is an exposure such that the print will not go beyond a proper and sufficient depth whatever (reasonable) time it may remain in the developer. This is a particularly important point, not only in making the best black and white prints of which bromide paper is capable, but more especially in the production of fine sepia prints by sulphide toning. The richest and most lustrous blacks in the shadows are secured by this thorough development, and its virtue is disclosed even more when prints are sulphide-toned. You may get a good black and white print by short development, taking out the print before it has got too dark, but a print of this kind will not sulphide-tone so well as one which has been developed as far as it will go. Hence, the practice of adjusting exposure so that development may be full and yet not yield too dark a print. With amidol or metol hydroquinone a time of development of four minutes is what may be called "full development." These two developers, and particularly amidol, are well suited for prints to be sulphide-toned. Metol is a developer which acts more rapidly and lends itself well to yield prints of a softer character.

Another point in developing bromides is to keep the print in the developer all the time. If the paper is being continually taken out and spread on the hand in order to examine it better there is great liability of yellowing of the high lights. The dark room should be so well lighted that there is no necessity to remove the print from the developer until rinsing it preparatory to putting it in the fixing bath.

I have talked above in reference to prints from a good and brilliant negative. In bromide work, however, a good deal may be done in the way of improving the results from defective negatives, by modifying the developer. Dilution of the developer with twice or three times its bulk of water will yield softer effects, usually without the vigorous blacks which are obtained with correct exposure and full development. On the other hand, an extra strong developer (less water in the formula) may be used where the utmost contrast is wanted in the print, say, in printing from copy negatives of line drawings or other originals. For such bromide prints the hydroquinone developer is a very suitable one, and in many cases where delicacy of half tones is not a matter of great moment, a vast improvement can be made by over-developing the print considerably, and, after fixing and washing, reducing it in weak hypo-ferricyanide solution, i.e., a clean, plain hypo solution of about 10 per cent. strength with just sufficient solution of potass. ferricyanide added to give it a pale yellow colour. Never use this reducer on bromide prints in which you value the delicate detail in

the high lights and half tones, for the reducer attacks these in preference to the shadow deposit

FIXING BROMIDES

Bromide prints may be fixed in either the plain or acid hypo bath referred to in the paragraph on an earlier page "Fixing Gaslight Prints". Usually the plain bath is used. It can be of strength 4 ozs hypo to 20 ozs water. Most bromide papers will come to no harm in a hypo bath of this strength so long as they are fully immersed in it. But the hypo bath should not be made up haphazard, for too strong a solution will sometimes cause blistering of the prints. The washing of bromide prints follows exactly the same course as those on gaslight paper.

FAULTS IN BROMIDE PRINTING

Prints which are veiled and flat with grey whites may be caused of course by fogging of the bromide paper by accidental exposure to white light or by too strong a yellow light in the dark room but with ordinary care the cause is not likely to be either of these. Such veiled prints are more likely to be due to exposure of the prints to white light while in the fixer. But even before the prints have had a minute or two washing. The beginner is often tempted to examine prints in daylight or in strong artificial light while they are in the fixing bath but it should be made a rule never to let prints see white light until they have had a minute or two's washing in clean water from the fixer.

Flat prints from decent negatives may also arise from a damp condition of the paper. In some cases paper can be fully restored by making it bone dry. It can be expected for this purpose to moderate heat very slowly in the plain water to make one or two thick cardboards bones bone dry by letting them become thoroughly hot for half an hour or so in front of the fire then laying out the sheet of bromide paper in them of course away from white light. The dry cardboard will absorb the moisture from the damp paper. If it is worth while sodium chloride can be used for the same purpose placing the paper in a closed box with a pound or two of chloride of calcium thoroughly dried by heating in an old saucepan over the fire.

But colour of bromide print arises chiefly from over exposure followed by an attempt to circumvent it by adding bromide to the developer. In these circumstances the print has a brownish shade instead of the pure black or bluish black of a properly developed print. The result may be satisfactory except for the colour in which case a very good remedy is to bleach and redevelop the print according to the method of chromium intensification. The bleach solution is—

Potassium bichromate	100 grs
Hydrochloric acid	3 drs
Water	10 ozs

The bleached print is washed until the yellow stain is removed, and then redeveloped with freshly mixed amidol developer.

This gives scarcely any intensification, but changes the image into one of a fine black colour. In fact, the colour which is produced in this way is some slight improvement on that of a properly developed print. It is an exceedingly fine and lustrous black, and, as the process gives a little extra brilliancy also to the print, it is one which is worth bearing in mind for use even on prints which are not defective in colour.

SILVER MARKS ON BROMIDE AND GASLIGHT PRINTS

Prints on glossy development papers are many of them subject to an annoying defect which takes the shape of scum-like markings over the whole print or of definite dark lines. The cause is abrasion of the emulsion surface, the shape or character of the process, say in folding the paper when putting up to a number size in rubbing the paper against the relative, against the sheets in rubbing the paper against the flat surface of the developing dish or even in the use of developing trays containing sediment. These distress marks scarcely ever appear on matt or vignetted prints, and they are makes of glossy finish. I have found in the market which are practically free from blemishes of this kind.

The cause is just mentioned, and to what must be done to avoid these marks. A 1 per cent addition of a 10 per cent solution of potassium cyanide to the developer is a partial preventive of them. The quantity for a 10 cc. of developer.

When the marks are on the print, they can be removed by rubbing the wet print with a clean cloth or a clean leather Rag or the print with putty. A very clean rag is more effective than simply rubbing with a cloth. The print should be washed in water, and the marks will be removed. The marks are not removed by the use of a 10 cc. of developer.

TONING PROMIDE AND GASLIGHT PRINTS

A whole series of methods for changing the blue image of a bromide print to a different shade of colour is available. Of these by far the best is the so-called sulphide toning process, yielding prints of a warm, opalescent blue. Another quite satisfactory method is the hypodermic or cyanide prints, characteristic purplish-brown colour. Then there is the copper toning process, which gives tones ranging from warm black to a bright red. And finally, other toning methods by which the blue bromide image may be changed to green or blue.

SILVER PRINTS BY SULPHIDE TONING

I have referred to this process in a previous paragraph when emphasizing the necessity of full development for satisfactory sulphide tones. It is equally important that prints should be thoroughly fixed, otherwise the process may cause dark stains, due to patches in the prints which have not been fully exposed to the hypo bath. Thorough fixation is more important than thorough washing, and it is necessary to remember that the sulphide toning

process discovers defects in fixing which only time would disclose were the prints left in their original black condition.

Although endless formulæ have been given for the sulphide process, there is none better than a bleaching solution of potassium ferricyanide and ammonium bromide, the prints, after a brief wash, being toned or darkened in a bath of soda sulphide. The bleaching solution is:—

Ammonium bromide	100 grs.
Potass. ferricyanide	300 grs.
Water	20 ozs.

This solution keeps for a month or two. The soda-sulphide bath, however, does not keep well, that is, in the strength in which it is used. Perhaps the best plan is to make it up at the time of use by dissolving 3 oz. pure white sodium sulphide in 20 ozs. water. If preferred, a strong stock solution of the sulphide can be made up by dissolving 4 ozs. in 20 ozs. water. This keeps fairly well; the working bath is made from it by diluting 3 ozs. of it with water to make 20 ozs.

The prints to be toned are placed one by one in the bleaching solution, which in a couple of minutes should change them to a buff or very light brown colour. They are then rinsed in water for a short time only. It is best not to wash them more than five minutes, in fact, one minute's rinse in running water is sufficient. The prints are then placed in the sulphide bath, in which they should come to a full vigorous sepia or brown in a few seconds. If the sulphide bath does not act thus quickly it is a sign that it has lost strength by keeping or has been made up with impure sulphide. A rule should be made to throw all sulphide baths away after use. If that be done, the most common cause of failure in sulphide toning will be avoided.

One objection to the process is the disagreeable odour of the sulphide bath. As a matter of fact, it is not so much the odour of the bath itself but the distribution of the odour when the bath is poured away down the sink. A remedy for that is to pour into the sink a little solution of potassium permanganate and to empty the used sulphide bath into this. The permanganate instantly destroys the sulphide, as shown by the disappearance of its deep purple colour. If the purple permanganate colour entirely disappears on pouring in the sulphide solution, add a little more permanganate so that you have a purplish colour there whilst the sulphide bath is rinsed away. This plan will avoid practically all the objectionable smell of the sulphide solution.

Blistered prints as the result of applying the sulphide toning process are sometimes produced, usually in places where the water supply is of a very "soft" nature. The best preventive is to use for fixing the prints a bath which both fixes and hardens the emulsion surface at the same time. The bath of this kind made up with sulphite, hypo, chrome alum, and sulphuric acid, which is given in the "Formulæ" section of this book, is a very suitable one for the purpose.

About the only other failure which is made in sulphide toning is the occurrence of bright blue specks on the prints. While opinions differ on the precise cause, these spots most certainly arise from iron in some form or other, the spots being the same form of Prussian blue produced by the action of the ferricyanide in the toning bath upon an iron compound. Rusty tap water is, no doubt, one cause, and one which can be avoided by filtration of the water through flannel or one of the packed filters sold for attachment to the water tap. Another cause is iron impurity in alum which is used as a hardening bath for the prints. On this account an ordinary ammonia or potash alum is best avoided unless its freedom from iron impurity can be guaranteed. If prints require to be hardened in order to prevent blistering, it is best to use a bath of 1 : 20 formaline, or the hardening fixing bath (with chrome alum) just mentioned.

The tone yielded by the sulphide method varies considerably with different papers, and to some appreciable extent with different qualities of sulphide. In a general way, however, none of the tones are displeasing, the most usual complaint being that the toned prints are deficient in depth. The cause of this defect will most likely be found to be hasty development of the bromide in the first instance. I have dwelt on this item already. It, and the freshness of the sulphide bath, are the two chief factors in the process.

BRIGHT RED PRINTS BY TONING SULPHIDE TONED PRINTS.

I am afraid my leading makes this method sound complicated. It is in fact a simple after-process which can be applied to prints which have been passed through the sulphide toning process. It yields prints of bright red tones of almost crimson hue, affording very pleasing effects for small vignette heads or figure studies against a white ground. It is not much of a process for ordinary "solid" prints, either landscape or portrait. The process consists simply in toning the sepia prints in a bath of :—

Gold chloride	2 grs.
Ammonium sulphocyanide	20 grs.
Water	20 ozs.

The print tones steadily in this bath, reaching the bright red tone in from five to ten minutes. This formula should be made up as directed on a later page under "P.O.P." When the bright red tone has been reached the print is washed for a few minutes, and then placed for a minute or two in a hypo bath of strength about 3 ozs. hypo in 20 ozs. water, and finally washed.

HYPO-ALUM TONING.

A very effective and inexpensive method of toning both bromide and gaslight prints is that in which the prints are treated with a hot mixture of hypo and alum. It is no use making up this mixture in small quantities. It requires to be made in bulk, and to be got into working order, after which it can be kept in use for a very long time. To prepare the bath, dissolve $1\frac{1}{2}$ lbs. of hypo in 40 ozs. hot water, and when thoroughly dissolved add 3 ozs. of powdered

potash alum and stir until dissolved. Then put the mixture in a clean uncracked enamelled saucepan, bring it to the boil, and let it simmer for ten or fifteen minutes. Now the bath requires to be "ripened." Unless this is done the first lot of prints which are toned in it will be very considerably bleached (reduced in depth), while the tones will be yellowish, instead of the fine purplish-brown such as one sees in the commercial portrait and landscape postcards in the shop windows. To ripen the bath we can add to it a handful or so of trimmings from P.O.P. prints (before toning or fixing), or more conveniently about 20 grs. of silver nitrate.

The bath is used at a temperature of about 120° F. To this end it requires to be placed in a porcelain or uncracked enamelled iron dish, which is placed in a larger vessel containing water, which can be kept at a temperature some few degrees above 120° by means of a gas ring below. The inner vessel containing the bath should rest on two or three supports, not upon the bottom of the outer dish. Unless the dish containing the bath is a decent size compared with the prints, it is a rather awkward business to handle any fair number of prints. Moreover, it is essential that one should be able to move the prints freely about in the solution, otherwise parts of them are liable to get overheated, with consequent melting of the gelatine. A 15 by 12 dish is none too large for a moderate size of print, and the process is all the easier in working if one uses one or two specially deep dishes, supplied complete with the outer heater by firms such as Messrs. Illingworth and Messrs. Lilywhite, Limited. An average time of toning is about twenty minutes, the prints requiring an occasional turn-over whilst in the hot bath. They then require only to be washed for about half an hour to be ready for drying. As with the sulphide toning process, the best toning action seems to be obtained when prints have been developed with amidol.

COLD HYPO ALUM TONING

The hypo alum mixture tones also in the cold, that is, at a temperature of about 65 to 70° F. but then very much more slowly, requiring a time of from twelve to fourteen hours to secure the tone which is obtained with the hot bath in little more than as many minutes. Nevertheless, the cold toning process is quite a practical one. The bath is prepared as already described, but is used when it has cooled. Prints are placed in it and turned over and over for a few minutes, until thoroughly saturated with the mixture. They can then be left overnight in some place where the temperature will not fall below say 60° F. They then tone evenly, and in the morning require only to be well rinsed from the deposit which the bath contains and washed in the usual way for about half an hour.

LIVER OF SULPHUR TONING.

Another variation of sulphide toning consists in the use of the impure potassium sulphide sold (at the price of about 6d. per lb.) as liver of sulphur. This substance is a very impure material, and

its varying composition no doubt explains the differences which are experienced in its use as a toner. Moreover, the solution has a softening action on gelatine prints, and the latter should therefore be hardened, preferably by using the fixing hardening bath already advised for the sulphide toning method. Moreover, it is best not to dry the print between fixing and toning. A formula for the toning bath is as follows:—

Liver of sulphur	60 grs
Water	20 ozs
Ammonia, 880	A few drops

The liver of sulphur should be dissolved in boiling water, the bath allowed to cool down to 105° F. the ammonia then added, and the bath used at about this temperature. The toning action then takes place in a few minutes giving prints of a rich brown colour. I give this process for what it is worth although the results obtained with it vary very considerably in the hands of different workers.

Some two or three years ago an improvement in the use of liver of sulphur for toning was made by Mr E Fenske. It consists in using the "liver" in admixture with hypo, the formula for the toning bath being: liver of sulphur, $\frac{1}{2}$ oz; hypo, $\frac{1}{2}$ oz; water, warm, 20 ozs. This bath is used at a temperature of about 80° F., and, therefore on this account and also by reason of the softening action of the liver of sulphur on gelatine it is necessary to harden the prints, as just mentioned. The bath as supplied commercially by Mr Fenske, readily yields very pleasing brown and sepia tones. The yellow colour of the bath appears to stain the print but it comes out entirely in the wash water. The toning mixture, prepared by diluting the strong commercial solution with water does not keep after use and should be thrown away. It should be mentioned that this method is protected by patent, but the concentrated toning solution or license to compound it is supplied by Mr Fenske.

COPPER TONING

Although one could fill a book with methods of toning development prints yet there is only one other which I think requires to be added to the practical processes already described. It is that devised some years ago by Mr W B Ferguson. It is on the lines of the uranium process of toning but unlike the latter, yields results which can be depended upon to last. The toning bath is made from two stock solutions:—

A—Copper sulphate	60 grs
Potass. citrate, neutral	240 grs
Water	20 ozs
B—Potass. ferricyanide	50 grs
Potass. citrate, neutral	240 grs
Water	20 ozs

The toning-bath is made up by mixing equal parts of A and B. The print is thoroughly washed from the fixing bath, and placed in the toning mixture, in which it progressively changes through

a series of colours from warm black to red. Thus, the process is not so well suited for making a series of prints all of one tone, as is the sulphide method, unless it is pushed as far as it will go for the production of red prints. On the other hand, it is a very easy and certain process, which yields a most pleasing series of tones, and with scarcely any alteration of the original depth of the print. About the only defect which is liable to occur in the toned prints is a pinkish stain over the whites. This can be corrected by using more of the citrate in the A. or B. solution. The toned prints require only to be washed for about half an hour.

GREEN AND BLUE TONES.

It is not necessary to give here the formula for baths yielding these tones on bromide or gaslight prints. In the first place, they are given in the "Formula" section of this book. In the second place, these tones are seldom required, and when they are, are most conveniently produced by using one or other of the commercial preparations which are available in the form of tablet or carton chemicals. Messrs. Burroughs, Wellcome and Co., Messrs. Johnson and Sons, and the Leto Photo. Materials Company are three firms who issue blue and green toners for this purpose.

GLAZING PRINTS BY STRIPPING

Perhaps at this point I can most appropriately deal with the making of prints of extra high gloss by the stripping process. It should be understood that it applies equally to all gelatine emulsion prints, and therefore to ordinary P.O.P. and to self-toning papers prepared with gelatine emulsion. It is not applicable to collodio-chloride prints or to the prints on self-toning papers, and they form the majority in which collodion emulsion is used.

Working processes for glazing prints by stripping from glass or other material seem to present numerous difficulties to the inexperienced worker. The chief of these is the sticking of the prints to the glass instead of their separating easily when dry. There are several causes which contribute to this difficulty, as we shall see in a moment. It should be understood that the instructions which follow apply to the glossy variety of paper. Prints on other surfaces can be stripped from glass, but they do not, of course, yield the very highly glazed surface which is obtained from prints on the glossy variety of bromide, gaslight, or P.O.P.

Among the factors which determine ready stripping of the prints is the hardness or tough condition of the gelatine surface. In the case of some makes of paper, the emulsion surface is hardened when it reaches the user: with other papers there is an advantage in passing the fixed washed prints for a few minutes through a hardening bath of alum or formaline. On grounds of permanency formaline is better than alum. Both are effective in hardening the gelatine surface. The alum bath is a solution of about 1 oz. of ammonia alum, or potash alum, in 20 ozs. of water. The formaline bath is 1 oz. (fluid) of formaline, as purchased, mixed with water to make

20 ozs. Prints are put to soak in one or other of these for from 5 to 10 minutes, being turned over in the bath so as to ensure equal action. Before squeegeeing down on to the surface from which they are to be stripped they should be washed for a time which should not be longer than 10 or 15 minutes.

Another means of rendering the surface of gelatine prints hard is to make them thoroughly dry. Once the gelatine surface has become bone dry, it is hardened very much as though it had been treated with alum or formaline, and retains this hardness if not soaked for too long a time before squeegeeing: 5 minutes is sufficient.

The stripping process consists in applying the hardened prints to either glass, ferrotype, or celluloid: pressing them thoroughly into contact with a strip of rubber, or with a rubber covered roller (bar or roller squeegee), and then putting them aside to dry. When perfectly dry the prints should spring off on raising the corner of each with the blade of a penknife.

Of the three surfaces from which prints can be stripped glass undoubtedly yields the highest glaze, but is more liable to occasional sticking of the prints than ferrotype or celluloid. On the other hand, it is less liable to damage by accidental scratching than either ferrotype or celluloid. It is found that for some reason not fully understood, so far as I know, glass requires to be got into condition in which prints strip readily from it. In using plate-glass or stout window-glass it is necessary to clean the surface perfectly first, by letting the glasses soak in commercial nitric or sulphuric acid, mixed with about ten times its bulk of water. If sufficiently large dishes are not available, the mixture can be scrubbed over the glasses with an old nail brush, which, of course, will be ruined by the acid mixture. In making the mixture, avoid adding the water to the acid. The acid should be added to the water: the reverse order is liable, in the case of sulphuric acid, to develop heat of explosive violence. After washing from the acid, the glasses may be soaked in, or scrubbed with, a strong solution of ordinary washing soda, and then again rinsed under the tap. In this condition they are as fit for use as they can be made by such commercial means. Nevertheless, with many varieties of glass they are not in the best condition for ready stripping of the prints. To get them into this condition, apparently there is nothing better than to use them for the glazing of a few waste prints, which are squeegeed down so as to cover the whole surface of the glass, and then stripped off when dry. If any stick, they can be fairly easily removed by soaking the glass for a while in hot water and rubbing off the stuck prints with a blunt tool, such as a bevelled penny rule.

The ferrotype and celluloid sheets which are sold for glazing require no preparation such as the above, and, indeed, render unnecessary any polishing or treatment of the surface as requires to be done, with glass, when each lot of prints is put on.

In preparing glass for the laying down of the prints the polishing material which formerly was invariably used was French chalk. A little being dusted over the plate, well rubbed over the whole surface with a clean duster, and then lightly dusted off again

again with a clean duster which, as it picks up French chalk in regular work, would be used for the first application of the chalk. Of late years, however, many preparations which call for far less labour than French chalk have been placed on the market as glazing or stripping solutions. With most of them the glasses simply require to be rinsed under the tap free from dust, and then laid in a weak bath of the glazing solution whilst the prints are applied one by one to the surface. The glass lies under the liquid, the print is placed in position, the glass then rinsed for an instant, and the print rubbed fairly into contact with a bar or roller squeegee. An alternative plan which can be used with most stripping solutions is to soak the prints in the liquid and apply them one by one to the rinsed glass, or if is often sufficient simply to rub over the glass with the glazing solution by means of cotton wool or a small sponge soaked in the liquid. The prints straight from the wash-water are then laid in position and squeegeed into contact. The makers' directions for the particular preparation will show the system to be followed. Another very effective dressing for the glasses is a weak solution of ox gall which requires simply to be applied to the glasses with cotton wool or a sponge and the prints then laid on. A special preparation of ox gall which keeps well is supplied for this purpose by Messrs. Rheinlander.

In trying different prints, care must be taken to avoid the imprisonment of bubbles of air between the print and the glass. For this reason some workers prefer to place the prints upon the glass while the latter lies under water in the glazing bath. But if the prints are well squeegeed down in the ordinary way there should be no air bubbles left between the two surfaces. For this it is essential to have a squeegee of really soft rubber. I do not think it matters whether it is of the bar or roller pattern: the essential thing is that the rubber should yield to the surface to which it is applied. If the rubber of either pattern of squeegee has become hard or 'pebbled' with age it is almost impossible to get proper contact and easy moreover to tear the prints.

The more quickly the prints are dried on the glasses the better for their ready separation. But it must be remembered that too much heat cannot be used: otherwise the gelatine surface will run, the print be split apart from its sticking then firmly to the glass. In working upon a large scale the usual method is to stack the glasses on tables in a room which is warmed to a temperature of from 70 to 80° F. by one or two radiators or a closed combustion stove. Upon a small scale the prints will dry sufficiently rapidly if the glasses are stood upon the mantelpiece of a room warmed by an ordinary open fire. That gives some idea of the degree of warmth which is sufficient. In summer, prints will dry quite quickly enough if placed near an open window where they will get a current of air passing over them: exposure to the heat of summer sunlight should be avoided. In these circumstances, the prints are ready to come away from the glass in two or three

hours; with artificial heat, as used in commercial establishments, they are detached in as short a time as half an hour, but that means the use of a powerful artificial draught of air carefully adjusted to the maximum safe temperature.

It must be understood that the gloss obtained in this way is highly susceptible to damp. For this reason the prints will lose part of the gloss as the result of mounting them dry with a mountant which penetrates the paper more or less. Therefore, prints glazed by this process, they are chiefly used for photographs to be reproduced in the Press, are sent out unmounted, or are attached to mounts by a few touches of fish glue round the edges or by the use of the minimum amount of a thick non-penetrative adhesive such as the dextrine mounting pastes now largely sold.

There is, however, in the means of finishing off these glazed prints, a more effective way. It consists in applying to the back of each as soon as the surface of the paper back of the print is seen to be fully dry a wetting of buckram paper. Papers for this purpose are sold with an adhesive coating which simply requires moistening by Messrs. Criterion Limited, but any stout paper can be used, applying it to the back of the print on the glass with the thinnest possible coating of a stiff mounting paste. The whole is then left until thoroughly dry when the print with the mounting paper attached to it is stripped off. For most purposes such a print is sufficiently stiff to dispense with further mounting, but if it is thought well to mount it, it can be firmly attached to the mounting board with hot glue, the penetration of which to the glazed surface is prevented by the waterproof buckram.

DRYING PRINTS

Something should be said here too of drying gelatine prints, since the tacky nature of the gelatine surface makes it easy for prints to be defaced by particles of dust etc. during drying. Those who remember the introduction of gelatine P.O.P. years ago by the Ilford Company will also recollect the objections which were made to it in this respect as compared with the non-sticky surface of the albumen prints then in vogue.

According to circumstances prints with a gelatine surface are best dried by pinning them up or suspending them by clips from lines or by laying them out flat upon blotters. If the latter plan is used the special blotter sold for photographic use should be used on account of their freedom from hypo or other chemicals used in the making of ordinary blotting paper. Moreover, the specially prepared photo blotters are much more substantial, and will outlast several lots of ordinary blotting paper.

The dust difficulty is largely avoided by rigging up some form of drying cupboard, often to be readily extemporised from a good-sized packing case or from some corner of a room. The amateur worker who at times requires to place a large number of prints to dry can use to advantage a collapsible drying frame sold as the "Hedgeland" by Messrs. Sichel. The various shelves are covered

with blotters, and the prints laid upon the latter. If necessary, the whole rack can be protected from dust by throwing over it a good-sized sheet, formed by stitching together two or more lengths of fine muslin or "lawn," thrown over the rack, it keeps out a large proportion of dust particles such as occur in town air.

Provided that the gelatine surfaces have not been unduly softened by soaking long in wash-water of summer temperature, prints may be laid out to dry face down upon the fine gauze net which is supplied for the purpose, stretched on frames, by makers such as Messrs. Houghtons. The thinnest butter muslin is used in the same way, this method having the advantage that the print dries very much flatter than it does if exposed to the air with the gelatine surface upwards.

DRYING PRINTS FLAT.

In the case of prints on heavier paper, such as postcards, methods of ensuring the flatness of the finished prints are of importance, since they save an enormous amount of labour. Several plans can be followed :-

One is to nail down to a board a few narrow strips of wood placed parallel at a distance apart of about 5 ins. This is for postcards. The cards are placed longways between two of these runners, so that each is bowed up slightly; the 5 in. separation effects this bowing of the 5½ in. card. The cards are placed film side downwards; the bow which they thus assume during drying counteracts that which the card would assume (in the opposite direction) as a result of the contraction of the gelatine coating.

Another plan, more suitable for work upon a large scale, is to lay the cards film side down on gauze or butter muslin (stretched on frame) until the gelatine side is surface dry. Then, while the body of the card is still limp and flat from the moisture retained in it, the batch is laid in a pile under light pressure until completely dry.

Quite recently, in America, several patterns of mechanical driers employing artificial heat have been introduced, and appear to be exceedingly efficient in securing flat prints. The method consists, first, in placing all the prints under dry blotters and then rolling them thus between blotters of corrugated board. They are then placed in the drier, by which they are given a slight curl towards the reverse side. It is found that gelatine prints so treated lie flat when attached by the corners only to a limp mount, and remain flat unless subjected to damp and dryness alternately.

PRINTS "WHILE-YOU-WAIT."

Perhaps I ought to interpolate here a few words on the making of prints in the minimum of time from freshly developed negatives as done in the "While-you-wait" portrait businesses, and often also for prints required for Press reproduction. At a pinch, a bromide or gaslight paper may be squeegeed down to the wet negative, adhering water removed from the front of the negative, and exposure at once made in a printing-frame or printing-box. Such

a method obviously has its risks in the way of damaging the negative, and is liable to break down by contaminating the development paper with hypo which may still be left in the negative. The more practical method, and one which is largely used commercially, is to lay down upon the wet negative an extremely thin sheet of celluloid. Celluloid specially for this purpose is supplied by Messrs. Rheinlander in such thinness that the sharpness of the results from the negative is not affected to any appreciable extent, certainly not enough to make any difference in portraiture, and indeed without producing any deficiency in sharpness such as would be objected to, except in the case of subjects of extremely fine detail. Any drops of water on the front of the negative are polished off as before, and the dry bromide paper laid down on the celluloid. For such work, a quick-acting metol hydroquinone developer is used, the prints immediately fixed in a hypo bath of strength 4 ozs. in 20 ozs. of water, washed for about five minutes, treated in a hypo eliminator, such as "Hypono," and after a further five minutes' washing, as much moisture as possible squeezed out between blotters with a roller squeegee or one of the small domestic wringers. The prints are then sufficiently dry to give to the customer as they are, or they may be supplied in a folder mount provided with an inner cut-out, by which the still moist surface of the print is preserved from damage by the front cover of the folder.

Still another method of this rapid photography is to enlarge from the wet negative on to the bromide or, possibly, gaslight paper. For this it is customary to have a fixed focus enlarger, which may be of box-form, so that on insertion of the negative in the carrier a picture of sharp focus is obtained on the paper, which usually is of postcard size. In a daylight enlarging camera of this sort the negative will not come to any harm during the exposure; nor will it under proper conditions when using an enlarging lantern fitted with even an arc light. But a negative requires to be handled quickly in the enlarger stage, since much exposure to the heat of the lantern is pretty certain to damage the gelatine film. If a number of enlargements have to be made in this way from one negative, the latter requires to be well hardened by immersion for five or ten minutes in a formaline bath.

PRINTING-OUT PAPER (P.O.P.).

In practically every country of the world this type of paper has been very largely supplanted by bromide or gaslight, chiefly the latter. Nevertheless, P.O.P. is still largely used. For one thing, it is still the type of print which is preferred by many photo-engravers when the best half tone printing block has to be made. The bulk of the illustrations which appear in the daily Press are made from glossy bromide or gaslight prints, simply because time does not allow of a P.O.P. print being made. But where the best quality of half-tone block is to be produced for printing on a glossy art paper, then a P.O.P. print is generally preferred for the purpose, owing to its perfection of detail.

Moreover, the brownish purple colour of sulphocyanide-toned P O P is one which seems to photograph better for photo-engraving purposes than any other. Photo engravers, as a rule, prefer it and so do editors of books and periodicals who pride themselves upon the perfection of their illustrations. If such prints require to be worked up with brush or air brush before reproduction then a P O P print of semi glossy surface is preferred as it takes the black and white work better otherwise a print of the highest class obtained by stripping from glass or vulcanite as already described for development papers is the photo engraver's preference.

P O P requires a fairly good negative for the reason that the paper is made of practically only one kind and regards the pluck or contrast which it gives. In this respect it differs greatly from gaslight paper which is obtainable in a series of grades suitable for negatives down to those of a very flat character. True, there have been one or two P O P papers placed on the market for the purpose of obtaining print of good contrast from very flat negatives. But they have never come into anything like general use no doubt for the reason that they are very slow in printing as compared with ordinary P O P.

PRINTING P O P

A beginner finds some little difficulty in judging of the exact depth to which the P O P print should be taken when exposing it to daylight under the negative. It is necessary to print deeper than the finished picture is to be because the print loses a certain amount of depth in toning and fixing. But beginners often find that they misjudge this degree of extra depth and so get prints which when finished are one of them too light or some too dark. I can give one hint on this matter which, I think will save the beginner many failures. It is that the degree of over printing which is required is greater when a negative prints quickly and is correspondingly less when a negative takes a long time to print. In other words if the negative is a clean quick printer which yields an image of the depth required in the finished print within five or ten minutes in diffused summer light then you want to over print considerably to a degree such that the highest lights in the picture are distinctly clouded over whilst the heaviest shadows have a blurred or choked up appearance. On the other hand if the negative is a slow printer, requiring from fifteen to thirty minutes or more then it will be found that the same degree of over printing will result in a picture which is too dark when finished. Usually a hard or "contrasty" negative requires less over printing than one which is flatter.

Moreover it must be remembered that prints require to be more deeply printed if they are to be toned in the combined bath—that is, toned and fixed at the same time. They can do with a somewhat less degree of over printing when toning by the

"separate" method of toning first and then fixing after washing. We will take this second method first.

WASHING BEFORE TONING

P O P prints may be kept for a day or two before toning if stored away from light and damp. But they are best toned, as is usually done, on the day they are printed. The first thing is to wash them in plain water. Place the prints in succession face down in a dish of clean water one by one. As you do this you will see that the water usually becomes milky owing to the silver which dissolves out of the papers forming chloride of silver (the milkiness) with the small quantity of salt which is present in almost every water supply. This salt is a means of telling us that the prints have been properly washed. For the object is to wash out the soluble silver compounds in the papers, and when that is done the prints in salting in water will no longer make the water milky.

Prints should be placed in this first water bath quickly one after the other and the first one is in, the milky water should be poured off and the dish filled up with fresh. The reason for this is that in most cases the whole of the soluble silver in the papers is not turned into silver chloride by the tap water. Some of it remains dissolved as soluble silver salt, which is liable to cause stains on the print if they remain for an unduly long time in the solution. Therefore pour on quickly the second lot of water and turn the prints over. By "turning over" I mean (in this and other directions where the word is used) bring the bottom print to the top and so exactly until the whole number are in the order in which they were placed in the dish. Then quickly pour off the wash water. Nos. 2, 3 usually four or five washings are ample. The washes called Nos. 1 and 2 are more conveniently made by a somewhat different manipulation, namely by removing the prints one by one from the top and turning them to the second dish full of clean water. If the print have been through five separate lots of water in this way the "free silver" as it is called should be washed out of them. Test for this by noticing whether the wash water is free from any trace of milkiness. Usually, one can see this better by scooping up a little of the wash water in a small glass measure. The milkiness does not show well in a white porcelain dish.

I ought to add a note for the benefit of those who by some rare chance may use a water supply containing no salt such as free pure rain water. In this event the wash water will not exhibit the milkiness. It is no drawback that it should not do so but it is just as well to add a drachm or so of salt solution to each lot of water, when the latter will then serve to indicate how washing is proceeding.

BATHS FOR SEPARATE TONING

The standard method for toning P O P and the one which yields the finest results, is that in which a toning bath is used containing

ammonium sulphocyanide and gold chloride. Ammonium sulphocyanide should be in pure white crystals. It must be kept tightly stoppered, as it absorbs moisture greedily from the air, and is then liable to spoil. However, it can be made into a stock solution, which keeps fairly well. Dissolve 1 oz. in water, and make up the total bulk to 9 ozs. Every ten minims of this solution then represents 1 grain of sulphocyanide. But if you are toning P.O.P. only at infrequent intervals, it is better to weigh out the sulphocyanide crystals, as you can then be sure that this chemical is in the proper condition.

Gold chloride is bought in tubes containing 15 grains. It requires to be kept in a stock solution, a convenient strength of which is 1 grain in 1 drachm of water. To make this, scrape off the paper label of the glass tube, put the tube in a clean measure, and add 2 ozs. of distilled water. Smash the tube under the water with a glass rod, when the yellow crystals will speedily dissolve. It is a good plan to make a few marks on the tube with a three-cornered file before putting it in the water, as it will then break quite easily. When the gold chloride is dissolved, pour the yellow solution off from the fragments of the glass into a second bottle, and label: "Gold Chloride, 1 drachm 1 grain."

Now to make the toning-bath. A formula which works well with almost any make of P.O.P. consists of 50 grs. of sulphocyanide and $2\frac{1}{2}$ grs. of gold chloride in 20 ozs. of water. To make this up, put 8 or 10 ozs. of clean water (no need for distilled water, though it is better) in a 20-oz. measure and add 300 minims (equals 30 grs.) of the sulphocyanide solution. In another measure put $2\frac{1}{2}$ drs. of the stock gold solution (equals $2\frac{1}{2}$ grs. of gold) and add about 8 ozs. of water to it. Now add the weak gold solution to the sulphocyanide (not *vice versa*), about an ounce at a time, which addition causes a deep red colour, which disappears on stirring or slightly shaking the measure. After adding all the gold in this way, make up to the full 20 ozs. with water.

If the bath is made in this way with cold water, it requires to stand for about twelve hours in order to ripen, but if hot water (rather hotter than the hand can bear) is used for diluting both the sulphocyanide and the gold, the bath can be used as soon as it has cooled down.

TONING THE PRINTS.

This is again an operation in which many beginners find difficulty—difficulty, that is, in getting a series of prints which are all of the same tone. If you think a little, you will realise that it is not surprising that the bath, as commonly used, should give different tones. Each print as it is placed in the bath absorbs a certain amount of gold. The bath becomes correspondingly weakened, and thus the prints which are put in afterwards are being toned in a bath which is weaker and weaker, as compared with that used for the first prints. This is one cause of difference in tone, another, of course, is the keeping of prints in the bath for a longer or shorter time. The effect of both causes is largely minimised by working on a different system than that (if it can be called a system at all) of dribbling prints a few at a time into the whole bulk of the

bath, taking them out after they are done and then putting in others. The better plan, particularly for the beginner, is to mix up just enough bath to tone the batch of prints, and to place all the prints in at the same time (as quickly as you can), to take them out when toned and then to throw away the bath. Usually a batch of prints is too big for all to be manipulated at one time in this way, and therefore we resort to the plan of dividing the bath up into several lots and of toning a requisite number of prints in each. P.O.P. papers vary considerably as regards the amount of gold required for toning them. Some will require 2 grains, others more, for a full sheet of paper representing 36 quarter-plate or 16 half-plate pieces. On this basis it is not a difficult matter to make up just the quantity of bath which will serve for the toning of the number of prints in hand, and the results as regards evenness and quality of tone will repay the trouble of the little calculation. Makers of some papers, for example, Kodak "Soho," draw up their instructions for toning on this "system" basis.

The point at which to stop toning is judged with most papers by holding the print up to the light. The shadows should be free from marked redness. If, in toning by the rule as above, the bath with its full quota of prints will not tone to this stage it is a sign that it requires more gold. If it tones prints too quickly, say in less than 5 minutes, it is a sign that the bath contains too much gold, or is too strong in both gold and sulphocyanide. Usually, the maker's toning formula will not exhibit either of these defects, and can be always adapted to toning by rule.

The toning operation itself is best done by weak daylight, that is, in a room with the blinds down, or a curtain over the window. This allows of the print being held up for a moment to unscreened diffused light (by raising the curtain) in order to judge if it is done. Toning can be done quite well by artificial light, although it is not quite so easy then to judge the point at which the prints are ready for taking out of the bath.

WASHING AFTER TONING.

It is just as important to wash prints between toning and fixing as it is to wash before toning. On removing from the toning bath prints should be passed into a large dish of water. If a lot of prints accumulate in a small bulk of water the latter accumulates the toning chemicals in it and prints tone further. This further toning is liable to occur in handling a fairly large batch of prints, and therefore some workers prefer to pass prints into a stop bath of soda sulphite (about 50 grs. in 10 ozs. of water), which immediately arrests the action of the toning bath.

In washing between toning and fixing the greatest care is necessary to avoid contact with the minutest trace of hypo. The dish for this washing should be beyond suspicion, that is, one which has never been used for hypo or has been chemically cleaned, best with a solution of potash permanganate containing a little sulphuric acid. Hypo at this stage is an almost certain means of causing pinkish stains when the prints come to be fixed and washed. Usually three

or four changes of water between toning and fixing are sufficient, the prints being "turned over" in each successive lot

FIXING P O P PRINTS

The fixing bath for P O P should contain plain hypo without any other addition. An acid bath containing sulphite, alum, or any other chemical should never be used. Moreover the strength should not be more than 2, or at most 3 ozs of hypo in 20 ozs of water. The image of a P O P print will not stand fixing in the stronger hypo baths which can be used without fear for development papers. The time of fixing should be from 10 to 15 minutes.

WASHING P O P

More care is required in washing P O P prints than in any other process not because it is any more difficult to wash out the hypo from them but because the P O P image is more susceptible to damage by any minute quantity of hypo which may be left in the film. On the other hand too long washing affects to some extent the quality of the prints the brilliance suffers somewhat by protracted soaking in water. If prints are kept on the move in a washer or by repeated transference from one dish to another there should be no need to wash for longer than one hour and a half.

COMBINED TONING AND FIXING

So far we have considered only the finishing of P O P prints by the separate toning and fixing process. It represents a somewhat formidable series of operations one which has undoubtedly driven the amateur worker to the speedier development and self-toning papers. However by toning and fixing at the same time in a so called combined bath P O P is a much more speedier process, the results are very little inferior to those by separate toning and if the method be not abused the results should be fully as permanent. The combined bath is one which contains not only gold and other chemicals which contribute to its toning action but also hypo by which the prints are fixed at the same time. It will thus be seen that there is a danger in the use of a toning bath of this kind, for the prints may be fully toned before they have had time to fix. If they require to be removed a little more than five minutes it is quite likely that they will not be perfectly fixed. One remedy for that is to reduce the speed of toning of the bath by adding water to it, say an equal bulk but very often a combined bath does not then give such good tones as it does when of full strength. A better plan is to make it a rule to pass prints straight from the combined bath into a fixing bath of plain hypo of 2 to 3 ozs in 20 ozs of water so that they will be assured of complete fixation. A further danger connected with the combined bath is that as it remains in use for the toning of a considerable number of prints it cannot be depended upon in every instance to indicate its exhaustion by ceasing to tone. It is often found that although the real gold toning ceases to take place (that is when the gold

is all gone) the bath still continues to exert a toning action which is not permanent in its results, since it is produced not by the action of the gold but by the various sulphur compounds which are formed in the bath. The preventive of this effect is to use a given quantity of the combined bath only for so many prints. Most makers of combined bath or combined "toning and fixing salts" indicate the number of prints which can be safely toned in a given quantity of the preparation. And the bath should be thrown away when that number has been treated.

In use the combined bath is very simple. The prints are placed dry into it as they come from the frames, are kept on the move until sufficiently toned, and are then (preferably) passed through a bath of plain hypo before being washed. Many formulæ have been given for combined baths, though I imagine that most amateur workers prefer to avoid the trouble of compounding them. Therefore, I will not trouble to give more than one formula, an excellent one recommended some year or two ago by Mr. H. W. Bennett for Ilford P.O.P.

Each constituent of the bath will keep in solution satisfactorily for a very long time :-

A—Hypo	1 lb.
Water, sufficient to make	32 ozs.
B—Ammonium sulphocyanide	2 ozs
Water to	8½ ozs
C—Lead acetate	1 oz.
Water to make	8½ ozs
D—Gold chloride	15 grs.
Water	3 ozs
E—Ammonia (880)	3 drs
Water	10 ozs.

The lead acetate should be dissolved in very hot water, as nearly boiling as possible. The solution will be cloudy, and should be shaken up before measuring out any quantity required.

To prepare the toning bath, take 3 ozs of A and 3 drs each of B, C, D, and E, and add sufficient water to make the total quantity up to 10 ozs. This quantity of bath is sufficient for eight whole-plate prints, for fifteen half-plate, or for thirty-two quarter-plate.

It is very important that the solutions should be mixed in the order of the letters of the alphabet. The necessary quantity of A should be taken first, B added next, then C, and so on. After measuring C the measure must be thoroughly rinsed before using it for D, and again thoroughly rinsed before measuring E.

The minimum time for the prints to remain in the bath should be twelve minutes. This is most important to ensure perfect fixation, and, consequently, stability.

Very deep printing is necessary for toning and fixing in this bath. The tone is judged as the prints lie in the solution, the final colour being that which they have at the time of being taken from the bath.

OTHER METHODS OF SEPARATE TONING.

Before leaving the combined bath it ought to be said that the sulphocyanide formula is not by any means the only one which can be used, but it is the only one which yields the characteristic purplish tone which is generally wanted in P.O.P. prints. Many other toning formulae can be used and are of service particularly when warmer tones than those given by the sulphocyanide are desired. One such formula, recommended some years ago by Mr. G. T. Harris for the toning of postcards upon a commercial scale, deserves to be mentioned. A stock solution is made of:—

Sodium acetate	4 ozs.
Gold chloride	60 grs.
Distilled water	15 ozs.

In making this stock bath the gold chloride (which is acid) is first neutralised by adding pure chalk, and the bath, after the addition of the acetate, is allowed to ripen for at least twenty-four hours. In making the toning bath, $1\frac{1}{2}$ ozs. of the stock solution are mixed with 60 ozs. of water. This bath being strengthened by the further addition of stock solution up to 4 ozs. (=16 grs. of gold), which is found to be sufficient for the toning of two gross of postcards.

On the other hand, a method which I can strongly recommend to the amateur who has occasion to make a P.O.P. print only at odd times, is one in which the toning solution is applied to the print with a brush in quantity sufficient to tone the print fully but not to over-tone it. This is a very rapid though a very extravagant method, but it is a capital one for those who may want to make one or two P.O.P. prints, say, for reproduction in the Press. Make a solution of ammonium sulphocyanide, 70 grs.; sodium phosphate, 50 grs.; borax, 70 grs.; in 10 ozs. of water. To make the toning bath add 1 dr. of gold chloride solution (equals 1 gr. of gold) to 1 oz. of this stock solution. This makes a strong, quick-acting toning bath which is quickly brushed over the print with a large camel-hair mop. One requires to use a brush large enough to take up sufficient solution to tone the print. In the case of a quarter-plate print this is from thirty to forty minims. Lay the dry print on a clean glass plate and go over it in even strokes with the brush, first lengthways and then crossways. The print will tone in rather less than two minutes and the tone will be even and not overdone because the toning bath is practically exhausted in the process. It need hardly be said that the brush should be kept moving first one way and then the other across the print during the whole time. On account of its extravagance in both gold and time this, of course, is not a process for dealing with a batch of prints, but is, as I have said, a first-rate one for one or two. The results, as regards brilliance and quality of tone, are, I think, superior to those by the usual process.

SULPHIDE TONING OF P.O.P.

A good deal of experiment has been devoted to devising a satisfactory method of toning P.O.P. without gold, but none can be said

to be really satisfactory; at any rate, I know of no published formula for the process, although several trade preparations have been put on the market, the best of which appears to be the "Toneazy" of Messrs. Droege. It should be practicable to convert the image of disagreeable brick-red colour, obtained when P.O.P. is simply printed out and fixed, into one of pleasing sepia tone by the use of sulphide, but no method of doing this has so far proved to be sufficiently certain to come into general use. There is a field for experiment here, although it must be said that the dwindling use of P.O.P. makes it one without great promise of profit. So far, the most satisfactory method has been to print very deeply, to fix in the ordinary hypo bath, to wash out the hypo thoroughly, and then to pass prints through a weak sulphide bath, for example, 5 drops of the strongest ammonium sulphide solution (commercial) in 20 ozs. of water. Apparently P.O.P. requires to be quite fresh in order to work well with this process, otherwise the whites are stained. I mention the method here only in order to draw attention to it and perhaps to encourage some worker to improve it. If the printed-out image can be fully sulphided there seems no reason why prints should not be fully as permanent as sulphide toned bromides, which is saying a good deal.

REDUCING P.O.P. PRINTS.

Ordinary reducers, such as the hypo-ferricyanide, are not suitable for correcting P.O.P. prints which, through over-printing, are too dark when finished. For one thing, the hypo-ferricyanide reducer attacks the detail of the print more than the heavy shadows, giving an unpleasant and "measly" effect. Years ago I tried a whole series of reducers on P.O.P. prints, and among them found two which were really satisfactory in dealing with overdone prints. The first of these is the so called "Haddon's" reducer, made by adding a little ferricyanide solution to a solution containing about 10 grs. ammonium sulphocyanide in 1 oz. of water. This has a very even action on the tones of the print, and it does not spoil the general colour, as do many other reducers. Another reducer is the familiar persulphate, simply a solution of 5 to 10 grs. of ammonium persulphate in 1 oz. of water. This reducer certainly does alter the tone of the print, but it changes it more towards a neutral black, giving a very pleasing effect, though one hardly recognisable as a gold-toned P.O.P. No one, of course, would recommend these reducers for regular employment, but on occasions when a print has been made in a hurry and turns out to be useless through over-printing one or other of these formulæ may save the situation.

P.O.P. IN HOT WEATHER.

The gelatine emulsion of P.O.P. is more liable to give trouble in hot weather than is that of development papers to which very often special hardening processes are applied in the manufacture of the paper. P.O.P., owing to the number of baths through which it has to pass, and also to the softening action upon the gelatine of a sulphocyanide toning bath, often requires to be passed through a hardening bath. The best stage at which to use the bath is between

toning and fixing. The prints are first well washed after toning, as already directed, and are then turned over for five or ten minutes in a 5 or 10 per cent solution of alum. They are then washed again for five or ten minutes before fixing.

A point of special importance is the purity of the alum. Much alum which is sold is very impure, containing iron salts, so much so that the P.O.P. image is positively bleached or destroyed to a very considerable extent. I have seen prints which have been little more than shadows of their former selves through the use of a hardening bath of this impure alum. Alum can be bought free from iron, and makers of P.O.P. prints upon a large scale find it necessary to use alum of this assured quality. Usually either potash or ammonia alum, which is purchased in clear white crystals, will be found reliable. The powder varieties of alum are more open to suspicion.

DEVELOPING P O P

To complete these notes on print out paper reference should be made to the process which came somewhat into use before the days of gaslight papers—namely, that of printing P O P only faintly and then developing it up to full depth. This process still, too, has its use, for I know of no method which is so speedy a one for the amateur to take off one print from each of a large number of negatives of different degrees of density and colour. P.O.P. printed out in the ordinary way would be a very slow process; if one uses gaslight or bromide paper, it is necessary to be able to judge fairly correctly the exposure required for each negative in order to get a presentable print, but by using P O P and developing it, there is no necessity to give at all an exact exposure so long as one gives enough. If the paper is exposed so as to yield a light print showing detail everywhere, one will get a picture of full depth on development. If the exposure is more than this, the developed print is still of good contrast, but has a warmer colour. Thus, it is possible to group half-a-dozen or a dozen negatives into one large frame, expose one large sheet of P O P behind them for a time sufficient for the densest negative, and then, after cutting up the piece with a pair of scissors, to develop each separate part to a quite presentable print. In this way, a very large number of negatives can be proofed in a very short time.

The development process is easy and certain, provided one takes certain precautions. In the first place, the paper must be handled as though it was of gaslight sensitiveness. Best to load it into the frames by ordinary gas or electric light illumination and to develop it under the same conditions. Usually, there is no need to examine the paper in the frames because one knows what time is sufficient to give a print with detail in it. The exact depth does not matter.

Many developers can be used, but a formula which works exceedingly well is as follows. Make a stock solution of:—

Pyro	60 grs.
Metol	60 grs.
Acetic acid	1½ drs.
Water	5 ozs.

To prepare the working developer, $\frac{1}{2}$ oz. of this stock solution is mixed with 16 ozs of water at the time of use. The partially printed proof is placed in a clean glass dish, the developer flowed over it and kept on until the picture reaches the required depth or is a little deeper. Then, without rinsing, it is transferred to a fixer of:—

Hypo	2 ozs.
Soda sulphite	$\frac{1}{2}$ oz
Water	20 ozs.

The print develops in from one to two minutes, the developing solution becoming more or less turbid or muddy. It is a mistake to overwork the developer. The solution is very cheap, and the best plan is to use the minimum quantity for each print, and to throw it away after use. The developing dish, too, becomes stained with silver deposit after a time. When any pronounced brownish scum has formed on it, it is best to make it perfectly clean again by rinsing it with a little nitric acid, afterwards well washing in water. For this reason, a glass dish is best as one can be certain that it is perfectly clean.

As I have said, the prints by this process vary considerably throughout a batch as regards colour: this variation arising from different degrees of printing as well as, to a very great extent, from the colour of the negative. With some papers, the tone is a pleasing brown or sepia, not unlike that obtained by simple fixing. With self-toning paper with others it is of an unpleasing greenish hue.

If it is thought worth while, the prints can be passed through a combined toning and fixing bath after they have been fixed in the mixed bath of hypo and sulphite already given. But, usually, for the purposes for which this process is chiefly useful there is no occasion to supplement the method in this way.

COLLODIO CHLORIDE PAPER

This paper, otherwise known as C.C. or collodion P.O.P., is again a material which in this country, at least, has largely declined in popularity. It never was, and probably never will be, a process much in the favour of the amateur worker, although the results obtained with it are surpassingly beautiful. Probably no photographic print so well deserves the title of "handsome" as does a C.C. at its best. Unfortunately, the process suffers from several drawbacks, which are against its extensive use by amateurs. In the first place, it calls for a negative of first-rate quality and of considerably greater vigour than the amateur worker is accustomed to make. In the second place, the working of the process is none of the easiest, and for the production of the best results calls for an amount of skill and practice which many amateurs have not the opportunity or the leisure to obtain. By way of proof of this, it may be mentioned that the Kodak Company, when actively introducing the class of paper to provincial photographers in this country, adopted the method of sending round the countries a number

strators, one of whom would spend two or three days at a studio in order to familiarise the photographer fully with the working of the paper. With these features, added to that of daylight printing (always a disability from the amateur's standpoint), it is not surprising that collodio-chloride paper is almost completely absent from the processes represented in photographic exhibitions, which latter afford the best means of judging the popularity of this or that process among amateur photographers.

Among professionals the process has been supplanted to a considerable degree by the newer bromide or gaslight papers yielding a warm black tone by direct development. In these circumstances the process must be considered here at less length than its merits strictly deserve.

A notable feature of the C.C. paper is the remarkably beautiful prints which it yields of warm black tone. The toning process adopted for this effect is known as the "double bath." The prints are first toned for a short time only in a gold bath, and then, after washing, are toned more thoroughly in a platinum bath. The paper, however, lends itself quite well to the production of prints of a fine warm brown and sepia tone, as well as to tones of extra warm sepia, red chalk, and violet. These latter effects are secured by toning with platinum only, or by gold-toning after a preliminary bath of ammonia or salt, according to the warmth of tone desired.

HANDLING COLLODIO-CHLORIDE PAPER.

The paper, owing to its collodion emulsion, is of a much more delicate nature than is gelatine P.O.P. It is much more susceptible to marking by the fingers when handling it. Such touches with moist fingers show themselves in the finished prints in the shape of red patches where the toning action of the bath has failed to take place.

Moreover, the collodion emulsion makes the prints seem more difficult to handle in the various baths. Papers vary considerably, but all of them show a disposition to curl, instead of lying flat and limp as does a gelatine print. The best means of overcoming this curling tendency at the outset is to place the prints, when washing them preparatory to toning, in a very small depth of water. The prints are placed in this one on top of another, so that they press on each other and are only just covered by the water when the whole lot have been put in. By this plan the prints have not the opportunity to curl up, and if treated in this way at the start will lie reasonably flat in the succeeding baths.

THE "DOUBLE BATH" FOR WARM BLACK TONES.

Presuming that the prints have first been thoroughly washed as already directed under "Gelatine P.O.P.," and with the extra precaution just mentioned, they are first given a brief toning in a bath containing borax and gold chloride. Makers' working instructions are full in regard to this process and, naturally, should be followed. A typical formula is :—

Gold chloride	2 grs.
Borax, powdered	2 ozs.
Water	40 ozs.

Prints are placed a few at a time in this bath, where they tone fairly rapidly. All the toning that is necessary may take anything from a few seconds to a minute, according to the effect required. It is difficult to describe the appearance of the print in the gold bath at this stage when it is ready to be removed. Too short a toning here yields prints which are of brownish or greenish black when finished; too long a toning an equally unpleasing bluish black.

The next stage is to wash the prints thoroughly in several changes of water and then to tone them in the platinum bath. There are two methods of using the platinum bath, namely, toning one or two prints at a time for a short time in a strong bath, or toning a greater number together for a longer time in a diluted bath. The results do not differ greatly, nor is there much difference as regards the cost between the two methods. The stock solution is made up somewhat as follows :—

Potass chloroplatinate	15 grs
Phosphoric acid.	2½ drs
Water	7½ ozs

If the whole batch is to be developed together this solution is diluted with water to 60 ozs. or more. For toning only two or three at a time in a strong bath, 10 or 15 ozs. of water is mixed with about an ounce of the stock solution and the prints toned in this mixture, which is strengthened as required from time to time. In the platinum bath prints require to be toned thoroughly, in fact, it is difficult to over tone them and most necessary to avoid under-toning. The prints are easily judged to be fully toned both by observing them as they lie in the dish and by holding them up to the light; in each case, they should show no positive warmth in the shadows but should be a pure black colour.

The next stage in the process is to wash the prints thoroughly from the acid platinum bath. This is a most necessary operation, because any acid which is carried in the substance of the prints into the fixing bath will inevitably lead to yellow spots and stains, which may make themselves evident immediately the prints are finished, or may not appear until some time afterwards. Collodion paper requires particular care in this respect, and therefore the washing should be carried out through four or five changes of water, passing the prints one by one from one dish of clean water to the next. A further preventive of the carrying of acid into the fixing bath is to use, instead of plain water, for the last washing bath a solution of about 50 grs. soda bicarbonate in 20 ozs. of water. Some use a solution of borax of about the same strength equally for the purpose of destroying any traces of acid.

Fixing and washing are done as already described under "P.O.P."

PRECAUTIONS WITH COLLODIO CHLORIDE PAPER

Of the particular ways in which collodio paper is liable to give rise to failure the one which is least likely to be suspected by the beginner is the tendency of the paper to develop yellow spots, or general fading of the image is the result of slowness in drying. This applies equally to prints which are trimmed wet and mounted at once. Whether unmounted or mounted, prints require to be placed so that they become perfectly dry within an hour or two. If they are mounted the drying arrangement should be such that the mounts themselves also are not left retaining moisture. For this, mounts should be placed on a wire rack so that air can circulate freely round each and then put to dry in a warm well ventilated room. Once prints have become perfectly dry they seem to withstand the action of moisture in perfect safety. Collodio prints frequently withstanding moisture in indoor showcases by no means waterproof without suffering in any way.

C.C. prints are also particularly liable to disfigurement by black spots mainly caused by minute particles of metal detached from metal cutting blades, such as require to be used when trimming to ovals or circles. For rectilinear prints the guillotine pattern of trimming board avoids this form of trouble.

Of other toning formulae for the production of the warmer series of tones there is no occasion to write here since the necessary particulars and instructions are given in the "Formula Section" of this Almanac under COLLODIO CHLORIDE PAPER.

SELF TONING PAPERS

Thus the simplest of all printing processes calls for only a short chapter. It would be difficult in fact to write much of this paper, the manipulation of which has been reduced to the very minimum by the manufacturers. Still there are one or two points which I may dwell upon and thus usefully supplement the instructions supplied by the makers.

CELESTINE OR COLLODION

Self-toning papers are of two kinds, namely those with collodion and those with gelatine emulsion. The collodion papers are by far the most numerous and I must say the most satisfactory. Although papers with a gelatine emulsion are more awkward to handle in the various baths owing to their reluctance to lie flat, yet the balance of advantage in the case of self-toning papers, lies with the collodion for the reason that the collodion papers are much more certain in the tone which they give as the result of particular treatment than the gelatine papers. Perhaps some may consider that a disadvantage, for with collodion papers the results are limited practically to three tones—sepia obtained by simple fixing, purple, obtained by the use of a salt bath before fixing and warm black, obtained by toning in a platinum bath, followed by the usual fixing process. Tones other than these it is not very easy to get with collodion self-toning papers whereas the gelatine papers, in my experience can readily yield a very wide range of tone by alteration

in the strength of the fixing bath, the time of immersion of the prints in it, and the use of a salt bath. Whichever description of paper is used, the notes which follow apply, although I would not advise the use of a platinum bath for the toning of prints on the gelatine papers.

SEPIA TONES BY SIMPLE FIXING

As the makers' instructions tell you, the manipulation of self-toning paper is of the very simplest kind. It will be found that self-toning paper calls for a rather more 'contrasty' negative than ordinary P.O.P. or Bromide paper—a negative, that is, which is considerably more vigorous than one which yields a first rate print on print out paper. Printing requires to be somewhat overdone. The print needs to be exposed until the high lights are toned over and the shadows are just beginning to show a browned appearance. Here, as already mentioned under P.O.P., the degree of overprinting which is necessary in order to secure a final picture of the right depth depends a great deal upon the speed at which printing takes place. While printing from a dense negative or in a weak light calls for little overprinting, a rapid printing in strong sunshine or from a thin negative requires much greater density than is wanted in the final result.

As I have said, the procedure for sepia tones on self-toning paper is the use simply of a fixing bath of plain hypo usually of strength not greater than 2 or 3 ozs. hypo in 20 ozs. of water. Some makers direct that the prints should be placed straight into the hypo bath without previous washing in water, but a word requires to be said on this point. It must be remembered that most papers of this kind contain in the emulsion coating certain quantities of acid or (what amounts to the same thing) of acid salts. Therefore, if the prints are placed in the hypo bath without previous washing out of the acid, the hypo bath itself becomes acid and is liable to set up an action which endangers the permanency of the prints. There are papers which certainly yield a better tone when placed straight into the hypo bath, no doubt, but the result of the latter becoming acid, but I advise the user of a self-toning paper to make it an invariable rule to wash the prints in three or four changes of clean water before fixing them. If this practice happens to be contrary to the maker's instructions, and at the same time fails to yield prints of a satisfactory sepia tone, then the best thing is to use another make of paper. There are plenty of brands of self-toning paper which yield beautiful sepia prints in a plain hypo bath after washing.

Another means of counteracting the effects of acid passing from prints into the hypo bath is to add to the latter a little bicarbonate of soda, or even ordinary washing soda. If the paper will stand this addition to the hypo bath—that is to say, if the prints will tone satisfactorily in a fixing bath with this addition well and good. But it will sometimes be found that the addition of soda carbonate or even of bicarbonate has the result of reducing the toning power of the fixing-bath, the prints being of too warm a tone. Here, again, it simply means that we are being warned that the tone obtained by a plain hypo-bath is one which is not of the same degree

of permanency as one produced when we have taken the measures to remove acid.

As regards the strength of the hypo bath the maker's instructions can and should be followed particularly in avoiding the use of too strong a bath. It, however, some of the prints have been made too dark the use of a hypo bath of say double strength will sometimes prove of service in reducing the extra depth without sacrificing any quality in the print. But usually in this case the print requires to be left in the fixing bath for a considerably longer time than usual.

PURPLE TONES

The most beautiful results on self-toning paper are I think those of sepia tone obtained by simple fixing. But the purple colour obtained by use of a salt bath before fixing is nevertheless one which many workers prefer. The prints, first washed in three or four changes of water, are then placed in a fixer ten minutes in a bath of salt and then after a brief time in one of hypo. There is no need to give here any formula for the salt hypo bath since they will be found in practically every maker's instructions.

WARM BLACK TONES

Most beautiful results on practically every collodion self-toning paper are obtained by the use of a platinum bath. This yields a warm black tone much resembling that obtained on ordinary collodiochloride paper by toning first with gold and then with platinum. For this process the prints require to be printed considerably deeper, and then to be washed in three or four changes of water in the ordinary way. Almost any platinum bath can be used. I give the formula employed for 'Salt' dry paper -

Potass. chloroplatinate	3 grs
Citric acid	90 grs
Water	20 ozs

This bath should be made up a few hours before it is wanted. It can be used repeatedly with addition of a small quantity of fresh bath. Usually the prints require to be fixed in this solution until, on holding them up to the light, the deepest shadows are seen to have lost their warmth of tone and to resemble the other parts of the print.

The next operation is to wash the prints thoroughly in four or five changes of water. This is most important because the toning bath is acid and the acid requires to be washed out of the prints before transferring them to the fixing solution which may be of strength about 2 ozs hypo in 20 ozs of water.

TWO COLOUR EFFECTS

A method of securing very pleasing effects of a kind which evidently appeal to many people is to treat parts of the print only with a solution of salt and then to transfer the whole print to the fixing-bath. Thus the parts which have been treated obtain a purplish or grey whilst the untreated parts yield a rich sepia, which appears all the warmer by contrast with the purplish portions. This method,

if skilfully carried out, yields some quite charming effects, though when used without discretion it may equally result only in prints which suggest failures in toning. The print is made of the usual extra depth, as for simple fixing. It is washed in two or three changes of water for about five minutes, and then placed on a sheet of glass. The surface water is blotted off with pure blotting paper, and the parts which are to be of purplish tone are then gone over with a saturated solution of common salt applied with a sable brush. As soon as this has been done, the print is quickly and thoroughly rinsed in plain water and fixed in 10 per cent solution hypo, as usual. Visitors to trade exhibitions within the past few years will probably have seen many very tasteful examples of the use of this method with Seltona paper.

PERMANENCE

Occasionally one finds a complaint of want of permanency in prints on self-toning paper, although there is no inherent reason why a print toned with gold contained in the paper itself should be less permanent than one toned in a gold bath. Undoubtedly, prints on self-toning paper are largely found to last as well as those on P.O.P., which suggests that the fault is not in the paper, but in its wrong manipulation. Probably omission to wash with sufficient thoroughness before placing in the hypo bath is the most common cause of complaint of want of permanency in prints on self-toning paper.

A SPECIAL P.O.P. JAPANESE SILVER

While I am upon the subject of printing out paper I should do it briefly with a totally different type of paper which has been placed upon the market within the last few months. This is Japanese Silver, a new paper of the Platinum Company, and introduced by them no doubt as a consequence of the further great advances in the price of platinum metal which now stands at £10 per ounce. Japanese Silver is a print-out paper, but utterly different from gelatine or collodion P.O.P. It is a paper which is sensitised by impregnation as distinguished from one which is emulsion coated. The paper itself is of the Japanese surface, to which further reference is made in the later section of this article dealing with platinum printing. It is a paper of hard, semi-matt surface, incapable of softening in warm baths, and lending itself admirably to any kind of colouring. Silver Japanese prints can thus be dried between blotters or by aid of heat without any risk of damage to the surface.

The paper is printed under the negative until the picture is seen of a depth very little more than the finished print is required to be. It must not be overprinted to the degree which either gelatine or collodion P.O.P. requires. A further point which requires to be borne in mind in printing is that the paper is sent out by the makers in a very dry condition, and then prints of a bluish colour. If used in this state it yields prints which are distinctly softer than they are if the paper be allowed to absorb a certain amount of moisture before printing. The best plan, therefore, is to allow the paper

to remain exposed to ordinary damp air for a few hours in a dark place before use. It will then print to a brownish colour and will yield a more vigorous print. If, through uneven exposure of the paper to moist air, a print is pitchy, that is, bluish in some parts and brown in others, it can still be made to yield a print of the proper vigour by further exposing it to damp before proceeding with the toning.

The toning bath advised by the maker—one of platinum. A stock solution is made containing 4 grs. potass. chloroplatinate and 30 grs. citric acid in 20 oz. of water. To make the working bath 1 oz. of this solution is mixed with 6 ozs. of water. It will be seen that this is a very weak bath. Although potass. chloroplatinate is now a costly salt, yet platinum toning, for Silver Japane is more economical than gold toning. 1 gr. of potass. chloroplatinate serving for the toning of 30 to 40 hal. plate prints.

The prints require to be washed in three or four changes of water and then placed in the toning bath when they reach a fine warm black tone in about ten minutes. The warmer intermediate tones with Silver Japane recall of an exceedingly pleasing colour. At a large number of prints are being toned it is best to transfer each as it is finished to a bath of about 40 or 60 ozs. of water to which a few drops of ammonia have been added. This faintly alkaline bath immediately arrests the toning action. The prints are then given a further brief wash and are fixed in a bath of 2 ozs. hypo in 20 ozs. of water also with addition of a few drops of ammonia, just enough to cure the bath to smell slightly of ammonia. The ordinary washing for about an hour or repeated changes, completes the process.

The Silver Japane prints may likewise be toned in the ordinary combined toning and fixing bath as used for P.O.P. They may also be toned by using a much stronger platinum toning bath thickened with glycerine and applied very sparingly to the prints with a tuft of cotton wool. Used in this way, the print tones in about two minutes without any sacrifice of quality, and as I learn from Mr. W. H. Smith of the Platinotype Company with equal economy in platinum as compared with the bath method.

This new addition to the print-out papers will no doubt do much to revivify the popularity of this class of paper since the prints have a distinctive and fine appearance due to the natural beauty of the Japane surface and the rich tones which are yielded by the platinum bath.

PLATINUM PRINTING

As has been noted in the introduction to this article, platinum paper differs essentially from any of the printing papers which are here considered. As regards practical use it is not a print-out paper nor a development paper but something between the two, since the paper requires to be exposed under the negative until the image is faintly visible. In another respect platinum differs from other print-out papers. The image or picture is not attached to the paper by means of a substance such as gelatine or collodion as it is in the silver development and print-out papers. The sensitive

paper is innocent of any emulsion coating, the sensitive material impregnate the paper itself, and thus in the final print the natural surface of the paper is secured. Not only this, but the method of preparation (applying a sensitising solution to the paper) imposes upon the manufacturer the necessity of using a paper of the utmost purity and strength. For this reason a platinum print represents a degree of permanence greater than that of any paper the image on which is supported in gelatine for gelatine is a substance which will not resist such extraordinarily severe conditions as those through which a piece of pure paper will pass without damage.

Particularly in moist climates, but even under ordinary conditions in this country, the gelatine surface of prints is liable to damage by bacteria or even by insects—causes of impermanence (exceptional though they may be) to which a platinum print is practically immune. Perhaps, some of my readers will recollect the instance of a few years ago of a Platinotype print which is a result of the sinking of a war vessel remained in salt water for several months without becoming any the worse for this long immersion. In other words, both the image itself and the support upon which it rests are, in the case of a platinum print of the highest degree of permanence to which, it would seem, we shall ever be able to attain.

THE "SPEED" OF PLATINUM PRINTING

One other advantage of the platinum process which should appeal particularly to the amateur worker is the rapidity with which a final print is obtained. I am not speaking now of the speed of the actual printing under the negative. In this respect, of course, platinum paper is inferior to either bromide or gaslight paper. But the operations necessary in completing the exposed platinum paper are most rapidly carried out. Development is a matter of half a minute, the print then requires to remain for five minutes each time in three successive acid baths, then requires only, say, ten minutes' washing, and can immediately be dried between blotters, to be finally made bone dry, if necessary, before a fire or over a gas burner.

Still another feature of the process which deserves to be emphasised is the certainty with which the "tone"—either black or sepia of the print is obtained. Speaking broadly the tone is fixed by the paper and is not dependent as in silver print-out or development papers upon skill in using the toning bath or on the choice of a developer. By special modifications in the process other tones than black or sepia can be obtained on platinum prints and, within limits, with no less certainty than in the case of the silver papers.

For these many positive advantages there is, of course, something to be said on the other side. In the first place, in the absence of strong electric light, such as an arc or mercury vapour lamp, the paper must be printed by daylight although it is several times quicker in printing than P.O.P.

In the second place, the platinum process will not yield passable prints from positively wretched negatives. For making the best of them the amateur must have recourse to gaslight papers. Never-

theless, it is well here to correct the fallacy, which is still repeated in many text books on platinum printing, that a negative of really superlative quality is a necessity for platinum printing. First-class quality in the negative was undoubtedly an essential in the early days of the process, but of recent years platinum papers will yield their finest results with any negative which will give a good bright print on P.O.P.

Then, again, the paper requires to be kept dry both before and after exposure by means of a calcium chloride tube, although in this respect also platinum papers, and particularly the "Japine" variety of them, are much less susceptible to damp than formerly.

Lastly, there is the cost of the process. Platinum papers cost about three times as much as other printing materials, and with the constant demand upon the world's comparatively limited supply of platinum there is no likelihood of their becoming cheaper, but rather every probability that the price of any sensitive material in which platinum is used will advance.

PLATINUM PAPERS.

The inventors and original introducers of platinum paper are the Platinotype Company, to whose manufactures the word "platinotype" only applies. From time to time other makes of platinum paper have appeared upon the market; for example, those issued at the present time by the Ilford and Kodak Companies. So far as the English market was concerned, the products of a third manufacturer of platinum paper, Messrs. Gevaert, of Antwerp, became more generally used than those of either of the two competitors of the Platinotype Company just named. The German invasion of Belgium has deprived the photographic worker of these products for the present. For practical purposes, however, the manufactures of the Platinotype Company may be taken as the standard materials for use in platinum printing. The papers issued by them may be classed as follows:—

1. Platinotype black—cold development.
2. Platinotype sepia—hot development.
3. Japine platinotype, black—cold development.
4. Japine platinotype, sepia—hot development.

Papers in each of these four classes are issued of various surfaces and tints, thus affording in all a very great range of effects. In addition there is another paper made by the Platinotype Company, which cannot be described as "platinum," but is handled in a way so closely resembling ordinary platinotype paper that it may be dealt with in this section. This is "Satista" paper, in which the image is composed of both silver and platinum.

The essential difference between the ordinary and the "Japine" Platinotype papers is that the latter have a specially prepared and harder surface of a semiglossy character, whilst the ordinary Platinotype papers exhibit the natural surface of the paper stock. Ordinary Platinotype papers are thus obtainable in various grades of surface from smooth to rough, whilst in the case of "Japine" papers the surface is the same throughout. In both varieties of

paper a cream (buff) tint can be had. We will first deal with the manipulation common to both classes of paper before taking up the points in regard to which the papers are different.

KEEPING THE PAPER DRY.

Damp is the enemy-in-chief of platinum paper. The material is supplied by the makers in sealed tins containing calcium chloride which preserves the contents in an absolutely dry condition. It is necessary that the paper should be kept dry before, during, and after printing, otherwise the prints will lack the brilliance and "pearliness" characteristic of the best results. If the contents of a tin are to be used within a few days, it will suffice to use the tin supplied by the makers, but if to be kept for a longer period the paper must be stored in one of the calcium tubes supplied by the dealers. It is equally important that the negative should be dry before placing it in the frame, that the frame itself and the pressure back should be dry, and that the sensitive paper should be backed in the frame with a sheet of rubber cloth or celluloid. If printing has to be done out of doors in wet weather it is advisable to have the rebate of the printing-frame faced with rubber in order to make a damp proof bed for the negative to rest on; or you may use a printing-frame of a larger size provided with plain glass. When printing in ordinary dry weather, as is usually the case, these special precautions are not necessary, but it is necessary to transfer the paper on removal from the frame to a calcium chloride tube unless the prints are to be developed within an hour or two. In using the calcium tubes, see that the supply of calcium chloride is kept dry by heating it once in a while in a shovel or old tin over a stove.

HANDLING THE PAPER.

Unlike emulsion papers particles of the sensitive salts in platinum paper may be detached by tearing the paper instead of cutting it with sharp scissors, with a trimming knife, or with a guillotine. Such loosened particles may give rise to spots on the prints. All handling of the sensitive paper must be done in a light which is distinctly weaker than that in which it is safe to handle print-out paper. In this respect, platinum paper comes between print-out and gaslight papers, the sepia papers being more sensitive than the black. Paper should be loaded into the frames and the progress of printing examined in a weak indoor light, such as that of a room with the blinds drawn. Never examine the course of printing by opening the frame in full outdoor light.

PRINTING.

A little experience is necessary in judging of the depth to which the paper should be printed in order to yield a finished print of the right intensity, but with that experience the judging of platinum printing is as easy as that of print-out papers. On exposure under the negative the picture is seen as a faint brownish image upon a yellow ground (the high-lights). Exposure must be continued until detail is visible everywhere, save, perhaps, in the very highest

lights. If care is taken to have the paper dry and to keep it so during printing there will be little difficulty in judging of the proper depth, but if the paper is slightly damp it causes a less visible image, and therefore may easily be over-printed. For this reason platinum printers who are compelled to carry on their work in damp winter conditions often find it of advantage to expose by the use of an actinometer precisely as is described on a later page in connection with carbon printing, save, of course, that in obtaining the preliminary judgment of the printing value of the negatives platinum paper is used instead of carbon tissue.

DEVELOPER.

The staple chemical of the "developer" in platinum printing is oxalate of potash, and care requires to be taken to purchase a reliable brand, for a developing solution which is alkaline leads to degraded prints. A sample may be tested as regards this with a strip of red litmus paper. The solution should not turn the litmus paper blue. If it does, the best thing is to obtain oxalate of reliable quality or, failing that, to add drop by drop a little strong solution of oxalic acid until the solution just turns blue litmus paper red.

Although black papers—ordinary and "Japine" Platinotype—are described as for "cold development," that does not mean that the developing solution may be unduly cold; it should not be used below 60 deg. F.

Developing salts are supplied by the Platinotype Company specially prepared for their various papers, and these are a most convenient and reliable form in which to purchase the developing chemicals.

In dissolving the chemicals for the developing bath it will be found that with most kinds of ordinary tap water a milky solution results due to the lime salts in the water. Although it is best to use pure water, such as distilled, no harm is done by the milky deposit if the solution is allowed to stand for a day or so and the nearly cleared liquid poured off from the deposit. Many tap waters are improved by boiling briskly for five minutes, and then leaving to cool. It will be found that much of the lime deposit is thrown down and the water is thus better adapted for dissolving the oxalate salts.

DEVELOPMENT.

The print to be developed is floated face down in the developing solution. The picture appears at once, and the print taken off the solution immediately, so that it can be seen that there are no undeveloped spots or patches due to the solution not coming in contact with it completely. A glass rod run from end to end of the print will distribute the solution over every part and the print should then be put back quickly to float on the liquid and left there for at least half a minute. Under-development is a cause of granular prints, but longer will do no harm, and it does not matter whether the developer gets on the back of the print or whether the print is completely immersed in the solution. When developing large prints, and particularly with a hot developing bath (in the case of

the sepia papers), it is just as well not to immerse the prints since the paper then becomes softer and more liable to tear in handling

THE CLEARING BATHS

When fully developed, that is after about half a minute in the developer the print is pressed directly (without any washing) into a weak acid bath consisting of 1 part of pure hydrochloric acid in 60 parts of water, say, 2½ drs of acid in 20 ozs of bath. The acid to use is that sold as "hydrochloric acid, chemically pure" of specific gravity 1.16. A supply of this fixing or clearing solution is placed in three separate porcelain dishes, and the print allowed to remain for five minutes in each. The acid bath extracts the soluble, yellow iron compound from the paper and the original three baths are kept in use as long as No. 3 remains perfectly free from yellow colour. As soon as it is seen to have a yellow tinge a fresh lot of bath is poured out for No. 3. No. 3 is made No. 2, and No. 2 made No. 1, the original No. 1 being then thrown away or kept for recovery of the platinum. When developing a fairly large number of prints when it may be inconvenient to be constantly transferring the prints from one acid bath to another, a convenient plan is to make up a weaker bath for No. 1, namely, 1 part of acid in 150 parts of water. The prints can be allowed to accumulate in this bath without fear of then becoming tender, or in the case of some sepia prints, of the colour suffering. Then when all have been developed they can be passed to a No. 2 bath then to a No. 3 each of the full 1/60 strength.

Remember that the acid baths render the paper somewhat tender and therefore care requires to be taken in order to avoid tearing them. An ample supply of bath should be used in each dish so as to avoid rubbing the prints unnecessarily over each other. In the case of ordinary (not Japanese) papers excessive moving of one over another in the acid baths is liable to damage the prints by actually rubbing off the platinum image in places. Provided that the prints are lifted singly, beginning with the top one, from one bath to the next there is no necessity to turn them over whilst in the bath.

WASHING

Prints require to be washed in running water only for fifteen minutes. There is no hypo to be washed out only the free soluble acid and therefore no need for a lengthy wash. But no amount of washing will be sufficient if the acid baths have not done their work completely. If iron is left in the paper through insufficient treatment in the acid baths the prints will show a yellowish stain in the whites either immediately or afterwards. Just as in fixing silver prints with hypo, the really important part of the process is in the fixing bath itself rather than in the washing tank. In platinum printing the chief point is to see that the third acid bath is thrown away as soon as it gets a yellow tint.

DEVELOPER FOR COLD BATH BLACK PAPER

Up to now what has been said applies to all four classes of paper. We come now to what may be termed the standard platinum pro-

ness, namely, the making of prints of black tone in the developer at the ordinary temperature. A formula for this developer is as follows. A stock solution is made by dissolving 6 ozs. of oxalate of potash in 20 ozs. of water. The oxalate dissolves much more readily if the water is as hot as the hand can bear. To make the working developer, $6\frac{1}{2}$ ozs. of this stock solution is mixed with 14 ozs. of water and 1 oz. of saturated solution of oxalic acid added. A somewhat colder tone is obtained by using instead of the oxalic acid 1 oz. of potass phosphate, best the so-called potass monophosphate, of the formula KH_2PO_4 .

DEVELOPING UNDER EXPOSURES

If a print is badly under exposed the best thing is to throw it away. Longer development is of no service whatever. If it is thought worth while to make the best of such under exposure the developer should be warmed to a temperature of from 90° to 110° F. This will often yield a print of full depth and it will usually be of a warm colour tending to brown. In place of warming the developer the print itself after first floating on the developer may be warmed before a fire. The unpleasant colour of an under exposed print developed in this way may be remedied by a process which was suggested years ago by Dollond. It is applied to the print after clearing, washing and drying. The print is then re-soaked in water laid on a sheet of glass and the water blotted off. A little glycerine is then rubbed over it with the finger and then when the print has received an even coating a few drops of gold chloride solution are poured over the print and rapidly and lightly spread over the glycerine surface with a camellian brush. The gold solution is 15 grs. (1 tube) of gold chloride dissolved in 1 oz. of water. This action is to tone the brownish image to a bluish black, when this effect has been secured the print is well rinsed in water and then sponged back and front with an ordinary developer, such as metol hydroquinone in order to remove any traces of gold solution. I imagine that no platinum printer will want to go to all this trouble except in very exceptional circumstances.

DEALING WITH OVER EXPOSED PRINTS

Prints which are known to have been over exposed can be more satisfactorily dealt with. The best means is to reduce the activity of the developer by mixing it with glycerine. A mixture is made of 1 part of the stock oxalate solution (6 ozs. in 20 ozs. of water) 2 parts of water and 1 to 2 parts of glycerine. In this mixture the print will take about five minutes to develop and in this way a result of full contrast can be got from an over exposed print although the colour and quality will be inferior to that of a properly exposed and developed print.

HARD AND SOFT NEGATIVES

Negatives of poor vigour yielding flat and washed out looking prints, can be made to yield very much better results by addition to the developer of a little potassium bichromate. A convenient solu-

tion for this purpose is 30 grs potassium bichromate in 1 oz of water. It requires to be used cautiously, for a drop or two in 40 ozs of developer yields prints of distinctly greater vigour and further contrast is obtained by addition of more bichromate, up to about 1 dr in 40 ozs of developer, beyond which point addition of bichromate seems to be without effect. The activity of the bichromate is partially exhausted as prints are developed in the solution, and therefore further addition requires to be made in order to maintain the contrast giving property of the developer.

It is not so easy to make satisfactory prints from very hard negatives. The best plan is to raise the temperature of the developer slightly to 70° or 75° F., after adding to the solution a very little hydrochloric acid or 10 per cent solution of potassic chloride. A very slight addition of either chemical will make an appreciable difference as regards softening the contrast in prints. A rough and ready method is to transfer a little acid from the acid cleaning bath into the developer with the finger.

SEPIA PRINTS ON BLACK PAPER

Although the best results as regards colour, permanence, and general quality are obtained by using the special sepia paper, yet satisfactory sepia prints may be made on the black paper by addition of mercury, glycerine, and bichloride to the developer and the use of the solution at a temperature of about 130° to 140° F. A 10 per cent solution is made of mercury bichloride in alcohol and a developing bath prepared consisting of stock oxalate solution (6 ozs in 20 ozs of water) mixed with an equal bulk of glycerine. The mercury solution is added to this bath in quantity, according to the warmth of the tone desired. Addition of about 1 oz to 40 ozs of bath will give a warm black, larger additions, up to 4 ozs of mercury solution from cold to reddish sepia. In fixing these sepia prints obtained with mercury it is necessary to use a weaker acid bath, namely 1 oz hydrochloric acid in 300 ozs of water. An acid bath of the ordinary 1/60 strength will reduce the mercury toned prints, as will also the weaker bath if prints are left too long in it.

As regards the permanence and general usefulness of the process it would seem that the warm blacks and cold sepias last fairly well. In any case the process is not suitable for prints of very strong contrasts, owing to the production of warmer colour in the lighter tones than in the shadows. Moreover for this process the exposure wants to be as exact as possible since prints which are under timed yield a sickly colour whilst over exposure accentuates the effect of the process in exerting a different toning action in the shadows as compared with the high lights.

SEPIA PAPER FOR HOT DEVELOPMENT

The most satisfactory method of producing sepia platinum prints is by making use of the special papers which contain the chemicals necessary for the sepia tone. The developer in this case requires to be hot, for it appears difficult to manufacture a sepia platinum

paper yielding satisfactorily permanent tones with a cold developer. On the other hand, the hot bath sepia prints have shown themselves fully equal in permanence to the ordinary black platinum prints. Time alone is the test of permanence in such matters, but a useful idea of the capability of a sepia print to withstand the action of time can be obtained by immersing a strip of the print in a solution of potassium cyanide. Any bleaching or reducing action of the cyanide may be taken as a fairly safe indication that such prints will prove not to be fully permanent. Perhaps some day it will be found possible to make a cold bath sepia paper yielding prints equal in permanence to those on a hot-bath paper but for the present it seems as though the problem has not been completely solved. The cyanide test, however, is one which is found to indicate fairly well whether a print will last or not.

The developer for sepia paper is made by mixing 10 parts of the ordinary oxalate developer (1 lb oxalate in 54 ozs of water) with 1 part saturated solution of oxalic acid. This solution is used at a temperature of 160° to 170° F. As in the case of all the solutions for platinum printing dishes of porcelain or granite should be used, never enamelled iron, and the developer is kept at the required temperature (which must be controlled with a thermometer) by means of a ring gas burner. Some practice is required in the development of sepia prints since the developer loses water, by evaporation whilst it is kept in use and likewise loses the solution itself when each print is removed. It is, therefore, not easy to ensure the developer being kept at a constant strength. A rough gauge is to put a measured quantity of the developer into a dish at the start, and in the course of regular work to add water in quantity sufficient to bring the bulk something short of the original volume.

Sepia prints when wet should look rather flat and "washy," since on drying they gain considerably in vigour. If they look right in the washing dishes, they will be much over dark when finished.

Sepia paper, it must also be remembered, is more sensitive to light and requires to be handled with extra care before, during, and after printing. Moreover, the developing solution itself should not be exposed to unnecessary light whilst in use, and should be kept in the dark when not in use. Also, black and sepia papers must not be developed or cleared together in the same series of dishes nor even stored together in the same tin, otherwise it will be impossible to obtain pure blacks on the black paper.

JAPINE PLATINOTYPE PAPERS

The distinctive feature of the Japine papers is their hardened semi-glossy surface. In several respects this surface is an improvement on that of the unprepared (natural) papers issued under the single name "Platinotype." In the first place, the paper has a very slight sheen, not enough to be called glossy and yet sufficient to afford relief from the mattness of the ordinary Platinotype prints. Years ago Platinotype workers used to give a slight lustre to prints by means of megilp or waxing preparations; the Japine paper sup-

plies an effect which is something akin to that obtained by these methods. In the second place, the Japine papers hold the platinum image exceedingly firmly, so that there is no danger of damaging the picture by rubbing prints against each other, particularly in the acid bath. Lastly, the surface is admirably adapted for all kinds of colouring, and allows of colour being cleaned off and re-applied to an extent which is almost incredible unless one has had practical experience of it.

Broadly speaking, the Japine paper is handled in the same way as ordinary Platinotype. Then speed is about the same, and printing is done in the same way. A somewhat stronger developer is used, $\frac{1}{2}$ lb. of Platinotype Company's D salts is dissolved in 60 ozs. of water and used without further dilution. Like ordinary Platinotype paper, the Japine is also sold in a great variety for the production of warm tone prints by slow development. Special salts (sepia Japine) are sold to make the developer which is used at a temperature of from 160° to 170° F. Sepia Japine, however, is a paper which allows of considerably more control when dealing with negatives of less vigour. One of the best means is to add glycerine to the developer, say 1 part of glycerine to 6 parts of the working developer, using the mixture at a temperature not above 130° F.

The special surface of the paper being more impervious to solutions, care should be taken to allow ample time for full development. The time is short enough—about fifteen seconds with ordinary developer, about a minute with addition of glycerine.

The prints are passed through the acid baths in the way already described, are washed, and then before drying should be pressed between blotters, then laid between fluffier blotting paper to dry. This is necessary since Japine prints have more curl in them and require to be kept reasonably flat during drying.

Apart from the special salts supplied by the Company, other developers can be used for sepia Japine, namely a solution made by mixing the stock oxalate bath (6 ozs. in 20 ozs. of water), with twice its bulk of water. In this case the temperature should be 160° F. If you add a little oxalic acid to this developer, in the proportion of 1 part to 20 parts of potass oxalate you get a print which is a little brighter in contrast, whilst still further contrast is gained by the Japine sepia salts, and still more by the glycerine developer. The difference as regards vigour given by these four developers is nothing very great, but it is distinct, enough, in fact, to even up the differences which there may be between negatives which are all of reasonably good quality for the process.

Another point about sepia Japine is that the paper is suitable for the making of sepia prints by cold development by addition of mercury to a developer of special formula. This developer is as follows:—

Water	10 ozs
Potass citrate	$2\frac{1}{2}$ ozs
Citric acid	$\frac{1}{4}$ oz
Mercuric chloride (1 per cent. solution)	$\frac{1}{4}$ oz
Glycerine	10 ozs.

The best way to use this developer is by applying it sparingly to the print with a tuft of cotton-wool. Much less mercury is used in this process than is necessary for getting a corresponding sepia tone on black paper, with the result that sepia prints made in this way have been found to stand the test of time, whereas those produced by more copious use of mercury are almost certain to fade steadily within a year or two. Mr. W. H. Smith, of the Platinotype Company, recently showed at the Royal Photographic Society a print toned by this method some years before which was perfect in every way.

Another old process which is particularly useful in application to sepia Japine paper is that of after toning with catechu. This is really a species of staining the platinum image which was recommended years ago by Mr. Packham of Croydon. As applied to ordinary Platinotype papers, it has always been erratic, prints often refusing to tone. Moreover, the whites were always liable to stain. With sepia Japine, on the other hand, the process is a very useful one for warming up the sepia tone, and at the same time giving an exceedingly slight general stain which has a mellowing effect upon the whole print. A stock solution is made by boiling ordinary (commercial) brown catechu (1 part) with 20 parts of water for ten minutes, cooling, and adding 4 parts of alcohol. This forms a stock solution which keeps fairly well. To make the working bath, 1 part of the stock is mixed with 100 parts of water and the finished and washed prints allowed to soak in it. In the cold the action takes some hours, but if warmed to 130° F., toning takes place in about five minutes.

The uranium intensifier is another toning method which strangely enough appears to yield quite permanent tones when applied to platinum prints. I mention it for the information of those who are fond of experimenting in these toning methods, though, personally, the fine black and the rich sepia obtained by the ordinary simple procedure have always been good enough for me. However, those who have a liking for toning platinum prints to brown, red, or blue are referred to the issue (No. 115) of the "Photo-Miniature," where the details of the process worked out by an American amateur are fully given.

STALE PLATINUM PAPERS.

One of the things one is often asked is on the treatment of platinum printing paper which has become stale with keeping. Here a good deal depends upon the conditions under which the paper has been kept. If it has been allowed to become damp, there is no means of making respectable prints from it. If, on the other hand, the paper retains its original dry condition, then the flatness with which it prints may be obviated by well dosing the developer with bichromate in the way already referred to in a previous paragraph. But you must never expect to get the same fine colour upon a paper which has aged, however much the contrast of the prints may be improved by the use of bichromate. The tone will be of greater or less warmth even upon the black papers.

SATISTA PAPER.

This comparatively recent introduction of the Platinotype Company is a quite distinct printing paper. It is a platinum paper only in the sense that platinum always forms a part of the image; also the manipulation is exactly the same as for platinum paper as regards development and clearing, but the prints have also to be fixed in a hypo bath and then well washed. The reason for this is that silver enters considerably into the preparation of the paper. The bulk of the image is formed of silver, but in addition to that there is also, with the silver image, one of platinum representing all the detail of the picture. You can take a "Satista" print and place it in a bath such as acid permanganate, which will entirely wipe out the silver image, and you will have a light print in which all the detail of the negative is preserved. Thus, as the makers very rightly claim, a "Satista" print is of a very high degree of permanence. It is at least as permanent as a bromide print, but in addition it has a reserve of permanency, due to the platinum image, which, even in the event of the silver image fading, can be drawn upon in order to make a fresh negative from which other prints can be taken. But apart from these considerations, "Satista" has certain positive advantages of its own. The paper is about three times the speed of Platinotype, and thus is particularly suitable for printing by strong artificial light. For regular work an arc or mercury vapour lamp is necessary, although it is possible to make prints from small negatives by placing the frame a few inches from a metal filament lamp of about 50 c.p.

"Satista" is a Japine paper with the characteristic qualities already referred to. It is also made in two varieties, black and sepia, the former developed cold and the latter at a temperature of from 160° to 170° . A formula for development of the black paper is:-

Potass oxalate	8 ozs.
Oxalic acid	100 grs.
Hot water	40 ozs.

The prints are fully developed in about half a minute at the ordinary temperature and are then passed through two clearing baths. Each of these consists not of hydrochloric acid, as with the purely platinum papers, but of potass binoxalate $1\frac{1}{2}$ ozs. dissolved in 80 ozs. of water. This is a saturated solution and therefore should be made up with warm water and used when cold. Any deposit which forms should be allowed to settle out, and the bath preferably filtered by passing it through two or three thicknesses of muslin. The prints should remain in each lot of this clearing bath for ten minutes; longer will do no harm. They are then given a short washing (about ten minutes), and are then fixed for about fifteen minutes in hypo, 2 ozs.; water, 20 ozs.; turning them over constantly while in this bath. Finally, they are washed for about half an hour in running water.

For the sepia "Satista" the process and the solutions are exactly the same except that the developer is used at 160° to 170° . Considerable variation of the sepia tone can be made simply by reducing

the temperature of the bath, whence the reader will see that in order to secure uniformity of tone throughout a batch of prints it is necessary to keep the temperature of the bath the same by means of a thermometer.

Since the bulk of the image in a 'Satista' print consists of silver, the ordinary toning processes, such as sulphide, can be used, as can also methods of intensification or reduction in the case of prints, which may be a little too light or too dark. 'Satista' is, in short, a printing process which should appeal to the amateur worker on the score of its lesser cost in comparison with platinum. The results are indistinguishable from those on the platinum Japanese papers, whilst the permanency of the prints is hardly inferior to that of those by the platinum process.

THE CARBON PROCESS

The carbon printing process is one which most unfortunately, has been greatly disregarded by amateur workers of late years. This is much to be regretted for apart from the intrinsic beauty of the carbon prints and their un doubted permanence the process has the very greatest claims to consideration. As has already been briefly pointed out the carbon process is unique in the fact that without any variation in the manipulation it allows of prints of any colour being produced. At the same time the final effect in the print can be most richly modified by suit the choice of a transfer paper. This is to say the support on which the picture is finally obtained. Thus it is not too much to say that the carbon process yields a greater variety of effects than any other process or indeed, than all the other printing processes combined.

Against this must be set the radical differences in the manipulation of the process as compared with any other. Forbidding as the operations in carbon printing appear in cold print the difficulties are more imaginary than real. Indeed I would urge that to many an amateur worker who has not tried his hand at the carbon process, the novelty of the method should be a great attraction. There must surely be still in immense numbers of amateur photographers who practise their hobby not simply and solely for the production of prints on account of their value as records of scenes or friends but for the interest and enjoyment obtained by the practice of the photographic processes themselves. Looked at from this standpoint, carbon printing is perhaps *par excellence* the process which may be commended to the amateur worker.

CARBON TISSUE

The starting point of the process is "carbon tissue," that is a paper coated with a mixture of gelatine and pigment, and containing also other constituents such as sugar for the purpose chiefly of imparting suppleness to the material.

The pigment of course may be of any colour from black to red chalk. Catalogues of makers of carbon tissue in this country—the Autotype Company, Messrs Elliott and Sons, and Messrs Thomas Blinworth and Company—disclose the customary wide range of

colours among which choice can be made. With one or two exceptions the colour of the tissue in no way affects the working of the process, and, therefore, the carbon printer has at his disposal the means of making prints in colours most suitable to the subject and without any necessity of fearing that in so doing he is sacrificing anything to permanency.

The carbon tissue is sold either in the insensitive condition or ready sensitised. The sensitised tissue, however, cannot be depended upon to keep in good condition more than a few weeks, except under exceptionally good conditions of storage. On the other hand, the insensitive tissue will keep almost indefinitely and, therefore, the amateur worker will usually be wise to work with the insensitive tissue, preparing it for use by sensitising it in a solution of bichromate. After drying, it is printed behind the negative by daylight, but as no trace of the action of light can be seen, special means (of which later) have to be taken for the correct exposure.

In carbon printing, "development" of the printed tissue simply means treatment in hot water, and the only remaining operation is to wash the print for a few minutes in cold water or, if circumstances require it, to pass it for a few minutes through a bath of alum before this final brief washing.

TRANSFER—AND WHY IT IS NECESSARY.

Here let me stop to explain an essential operation in the carbon process, the necessity or purpose of which is sometimes puzzling to the beginner. The carbon process depends upon the action of light (through the negative) upon the gelatine of the tissue, rendered sensitive by the bichromate. The pigment itself, which forms the actual picture, plays no part in the process. Now the action of light upon the gelatine containing bichromate is to render the gelatine insoluble in hot water. Thus, the pigment is held fast by this insoluble gelatine and forms the picture. The pigment associated with the gelatine which still remains soluble is washed away on "development."

At first glance that seems an ideally simple process, but on a second thought it will be understood that the action of light (through a negative) upon the sensitive carbon tissue is first upon the surface of the tissue. The light which passes through the clear shadows of the negative causes the deepest deposit of insoluble gelatine; that coming through the half tones a shallower deposit, and that reaching the tissue through the most opaque parts of the negative, the merest surface film of insoluble gelatine. Therefore, as the result of exposure, there is formed over the whole top surface of the tissue, and extending downwards to a greater or lesser extent, a skin of insoluble gelatine. In other words, the parts of the tissue which have remained soluble are sandwiched between this top skin and the paper support. Therefore, in order to dissolve them away we must be able to get at them, which is done by "transferring" the exposed tissue to a new support. The exposed face of the tissue is brought into contact with a sheet of "transfer paper," that is a sheet of paper coated with partly hardened gelatine. The two

partly hardened gelatine surfaces adhere together in a few minutes and on the whole being placed in hot water the soluble coating, left at the bottom of the original tissue, softens and permits of the original paper support of the mixture of gelatine and pigment being pulled off. When that is done we have our original gelatine coating on the transfer paper, but with all its soluble parts exposed. These are speedily dissolved away by hot water, leaving the picture visible in all its light and shade and sticking to the transfer paper. All this seems horribly complex in print, but will be found absolutely simple in actual working.

THE TWO FORMS OF THE CARBON PROCESS

A moment's thought will make clear that the result of transferring the tissue to the transfer paper for development has the effect of reversing the picture in regards right and left that is to say showing the subject as it appears when the film side of a negative is looked at. This effect may be avoided, in the case of negatives on celluloid film by printing with the film side of the film in contact with the tissue. In the case of glass plates the thickness of the glass prevents this plan being followed as it would lead to a loss of sharpness although by a special means even that may be obtained. In the printing frame is placed at the bottom of a deep black box, so that the rays of light which reach it fall perpendicularly upon the negative there will be remarkably little loss of definition. This however is a somewhat slow and troublesome method and especially if a number of negatives are being printed at the same time. Reversed the picture can be avoided also by making a negative which is reversed in regards right and left, for example, by exposing the plate in the first instance glass side towards the light with the necessary allowance when focussing. This again has its drawback since such negatives are unsuitable for printing by the other processes which unlike carbon do not cause this reversal.

The practical way out of the difficulty is to transfer the printed carbon tissue upon a special form of transfer paper (the temporary support), on which it can be developed and from which it can be transferred to a final support yielding an unreversed picture. Thus there are two forms of the carbon process known as single transfer and double transfer according as the picture is finally obtained on the paper to which it is first transferred or is developed upon a temporary support and from that is transferred to the final support. Before coming to the practical details connected with carbon printing we may perhaps set down here the operations necessary in these two forms of the process.

- | | | |
|-------------------------------|---|---|
| | 1 | Sensitising the tissue |
| | 2 | Drying the tissue |
| | 3 | Printing |
| Single
Transfer
Process | 4 | Laying wetted tissue face down on transfer paper, squeezing and leaving under pressure |
| | 5 | Development in hot water after stripping off the original paper base of sensitive coating |
| | 6 | Washing and drying the print |
| | | |

The above represents the single-transfer process. In the double-transfer method the operations following stage 3 are:—

- | | | |
|--------------------------------|----|--|
| Double
Transfer
Process. | 4. | Squeegeeing exposed tissue to the temporary flexible support, and leaving under pressure.
Development in hot water, after stripping of exposed paper base of sensitive coating. |
| | 6. | Washing and drying of print on temporary support. |
| | 7. | Re-soaking of print on temporary support and squeegeeing it on to double-transfer paper (final support). |
| | 8. | Drying temporary and final supports together, and stripping off picture (on final support) when dry. |

SENSITISING TISSUE

The solution in which the tissue is rendered sensitive is one of potassium bichromate of strength from 5 to 2 per cent. A strength of about 5 per cent. is about the best for negatives of the vigorous character, which are the best suited for carbon work. Nevertheless, thin and flat negatives can be made to yield good prints by the use of the weaker sensitising baths. A formula for the sensitiser is:—

Potassium bichromate	1 oz.
Water	20 ozs.
Ammonia, 880	1 dram.

This sensitising solution will keep indefinitely before use, and can be used again after the tissue has been treated in it, if stored in the dark, although its keeping properties after use are somewhat uncertain. If sensitising is being done only at intervals of, say, two or three weeks it is far better to make up a fresh sensitiser each time and to throw it away when used. The sensitising solution should be used at a temperature of 60 deg. F.

For sensitising, provide a sheet of thick glass, say plate-glass, and two or three thicknesses of flannelette between a couple of strips of wood to make a special form of squeegee. The sheets of tissue are immersed for three minutes in the bath, brushing the gelatine surface the while with the flannelette squeegee so as to remove air-bells. At the end of the time the tissue is lifted out, laid face down upon the glass plate, and an ordinary flat rubber squeegee passed quite lightly over the back to remove the excess of solution. While the tissue is still on the glass slab, a bar of wood about 1 in. square section is laid upon the edge of the tissue, which is then fixed to the bar with a couple of push-pins. The whole is then gently lifted up and put to dry, the surface of the tissue being first looked at to see if there are any adhering drops of liquid which, if present, should be removed with blotting paper.

This sensitising can be done by any ordinary light, gas or electric light, or weak daylight, for the tissue is practically insensitive whilst wet. It must, however, be dried in the dark.

DRYING THE TISSUE.

Drying is, perhaps, the most important operation in the carbon process. Probably half the failures experienced by amateur workers arise from wrong methods of drying. It is necessary that drying should take place fairly quickly, i.e. within six or eight hours. If the tissue remains in a wet state for too long a time the gelatine is liable to become insoluble especially that is without exposure to light and thus to yield faded and veiled prints. On the other hand the tissue must not be dried by excessive heat and most important of all it must not be dried in such a way that it is exposed to the fumes passing off from a gas burner, oil stove, or similar source of heat which likewise have an insolubilising effect upon it. A very simple and inexpensive means of drying tissue is to place the bars to which the sheet is pinned in a large box provided with a well fitting lid interior sidepiece for the support of the bars and on the floor an ample supply of dried calcium chloride. It is no use adopting this method unless a comparatively large quantity of calcium chloride is used. This chemical is cheap enough (about 2s. per lb.) and when it becomes damp can be dried again over a stove by heating it stirring the while in a good sized old saucepan or baking tin. When using a box measuring say, 3 ft. by 2 ft. and about 18 ins. deep, 5 or 10 lbs. of the chloride will be a sufficient quantity.

Another plan is to squeeze the tissue on its removal from the sensitising bath face down upon a sheet of ferrotype such as is sold for the glazing of prints by stripping. Mounted on these ferrotype plates the sheets of tissue can be placed in any warmed room from which daylight is excluded and will then dry within a few hours. A sitting room in which a fire has been burning during the day will serve for the purpose, if the blinds are drawn down the tissues can be removed from the ferrotype plates in the morning and put aside in readiness for printing.

USING A SPIRIT SENSITISER

For amateur work however perhaps the most convenient plan of all is to use not the ordinary solution of bichromate in water but a so called spirit sensitiser that is a solution of the bichromate in a liquid which is much more volatile than water and allows of the tissue being dry and ready for use within a few minutes. One special advantage of this form of sensitiser is that one can sensitise the tissue on the morning of the day on which printing is to be done and thus be saved the disappointment of preparing material which on the next day through bad weather or other causes, cannot be used. The Autotype Company prepare a sensitising solution of this form which they issue with full instructions for use. The sensitiser is applied not by immersing the tissue in it but by brushing the sensitiser over the tissue by means of a "Blanchard brush," that is, a piece of flannellette fixed by an elastic band in a double fold over the end of a strip of glass. This "brush" is dipped in the solution and passed lightly, first lengthwise and then crosswise, over the tissue, the brush being dipped again into the sensitiser in

order to keep it moderately wet. By the time three or four pieces of tissue have been treated in this way, the first will be surface-dry, and is then re-sensitised in the same way. After this the double-sensitised tissue will be dry enough in about ten minutes for use on a varnished negative. When using unvarnished negatives it should be made crisply dry by holding it some few feet from fire in winter, or in summer placing for half an hour or so in a box well charged with calcium chloride.

Many formulæ for making spirit sensitiser have been published, among them the following of Carrara:—A 20 oz. solution of ammonium bichromate is made, namely, 4 ozs. in 20 ozs. of water. To make a 5 per cent. spirit sensitiser, one part of this stock solution is mixed with three parts of absolute (ethyl) alcohol.

KEEPING SENSITISED TISSUE.

If kept perfectly dry, in a calcium chloride storage tin, the sensitive tissue will be in perfect condition for use for several weeks after sensitising, but is best used as soon as possible. It is best to use a storage tin such as that supplied by the Autotype Company, in which the tissue can be kept flat under slight pressure, as the tendency of the dry tissue to curl is thus prevented to some extent. Tissue which is so thoroughly dry that it curls obstinately is unfit for printing, and requires to be brought into condition by exposing it to the atmosphere (not to light) for about half an hour before putting it in the printing frames. This is readily done simply by laying it out in the work-room and covering with a large focussing cloth.

PRINTING THE TISSUE.

The negative for carbon printing, whether by the single or double-transfer process, requires to receive what is called a "safe-edge," which is simply a narrow opaque strip around the edge of the negative, so that the extreme margins of the tissue are protected from the action of light. Ordinary lantern binding strip attached to the glass-side of the negative provides this "safe-edge," the object of which is to prevent the picture washing up and frilling round the edge of the image on development.

The printing-frame for exposure of carbon tissue under the negative should be of more solid construction than that used for other printing papers. The tissue always has a certain amount of curl in it and requires a fairly strong pressure to ensure proper contact between its surface and that of the negative. There is no better frame for carbon printing than the old box-pattern fitted with a plate-glass front and with hinged pressure boards provided with wooden screws, which many photographic workers of the old days still possess. This pattern of frame is now almost obsolete, but a box frame of solid construction with plate glass and heavy spring back is made in sizes from 9 by 7 upwards. A frame of this form should be used for carbon printing from negatives of whole-plate and larger sizes; for negatives up to half-plate size one of the well-made frames of the ordinary pattern, for example, the "Jay-Nay," can be used.

Tendency of the tissue to curl badly in the printing frame may be reduced somewhat by backing the tissue with a piece of ordinary flexible American cloth which has been well warmed. In any case, a waterproof backing for the tissue should be used as a protection against moisture during printing.

PRINTING BY ACTINOMETER

As it is impossible to tell from the appearance of the dark tissue the progress of the action of light until the negative we have to employ some form of actinometer in order to judge when the tissue has been correctly exposed. The principle of these actinometers, there are several patterns, is that we use a strip of ordinary P.O.P. as a means of gauging the strength of the light to which our negative with the tissue behind it is exposed. In order to use the P.O.P. for this purpose we require to obtain by preliminary trial or experiment some fairly correct idea of the printing value of the negative in terms of the actinometer which we are using. For example the simplest form of actinometer consists of a small box with a glass lid beneath which is a paper mask of light tissue having an opening of about $\frac{3}{16}$ in. square. In the body of the box is a little coil of P.O.P. about $\frac{1}{2}$ in. wide which lies under a guide below the opening in the bottom paper mask and in contact with the glass. As a rule the glass is coated with a slightly yellow film of varnish so that the time required for the P.O.P. to darken to the tint of the brown mask is about equal to that required to make a carbon print from a rather thin negative. Then with a little experience we shall be able to judge from the appearance of the negative that it requires

1 tint with the actinometer. Denser negatives will require 2 tints or 3 tints, the procedure being to expose the actinometer side by side with the printing frame containing the tissue and to pull the strip of P.O.P. forward as soon as the action of light has caused it to darken to the tint of the mask. The time required for the P.O.P. to darken twice to this tint will be the exposure for a 2 tint negative and so on for three or four tints.

Another pattern of actinometer is one in which a strip of P.O.P. is exposed behind a scale of patches (or they may be small negatives) as in the 'Burton' actinometer, each of greater density than the preceding. With this pattern of actinometer exposure of the one strip is continued until a certain depth of tint is obtained under that patch of the series which it is judged corresponds with the density of the negative.

The beginner will save himself much trouble by finding out the actinometer value of his negatives on P.O.P. in the following way. Take four or five negatives ranging in density from the thinnest to the most dense you are likely to use and put a piece of P.O.P. behind the highest light in each—in portraiture the face will be the best part to test. Expose these and the actinometer to light simultaneously and print to the depth required for an untinted proof perhaps a little lighter with the thinnest one first keeping an eye on the actinometer and note whether the latter registers one tint, one and a half or more. Then letting the actinometer go

on all the time, note how many tints are required for each of the others. Mark the number of tints necessary upon each negative, and they will serve as standards of comparison for any others which have to be dealt with subsequently. It is essential that the actinometer and negatives are so placed that an even light falls upon all of them, or uniform prints must not be expected. It is a good plan at the commencement of a day's work to get off and develop a print of each of the batches of tissue to be used, so as to know what allowance to make for the speed of each.

KEEPING TISSUE BEFORE DEVELOPMENT.

It is necessary to preserve the tissue in a dry state, and of course away from light, until development. If kept in a condition other than that of perfect dryness the effect of the action of light continues to go on even in the dark, with the result that prints which were correctly exposed will be found too dark when developed. Usually prints will be developed within a few hours of exposure, but even so the exposed pieces of tissue should not be allowed to lie about exposed to the air, but should be placed in a calcium chloride tube or box. In some cases, when dealing with very dense negatives, advantage may be taken of this continuing action of light in order to obtain prints of full depth with exposures which without it would be inconveniently long. That is a plan which the expert carbon printer may utilise at times as the result of knowing exactly from experience what effect a subsequent exposure to moist air will have upon a partially printed tissue.

While upon this subject, mention may be made of a little expedient recorded some years ago by Mr. Ernest Marriage, namely, that this continuing action of light may be avoided altogether by soaking the printed tissue in two or three changes of water, and then drying it for development at any later time. Mr. Marriage found that such exposed and washed tissue is rendered insensitive, can be dried in daylight, and after storage for a month in an ordinary drawer can be squeezed down and developed satisfactorily.

The various operations considered up to this point apply without any difference to both the single-transfer and double-transfer process. We must now consider the course to be followed according as one or the other of these two methods of preparing the final prints is followed. We will take the single-transfer method first.

TRANSFERRING TO SINGLE-TRANSFER PAPER.

Single-transfer paper, as supplied by the makers of carbon materials, is ordinary stout paper bearing a coating of partially hardened gelatine. It is sold in a variety of tints and surfaces ranging from a fine white matt to a paper of cream rough matt, according to the final effect required in the print. The beginner is advised to choose a thin and smooth paper, since the heavier and rougher kinds call for a little more care in handling in order to obtain perfect adhesion.

If any special paper requires to be used for the final support of the carbon picture, it can readily be converted into a single transfer

paper by giving it a coating of a mixture of gelatine and chrome alum. A good formula is —

Gelatine	1 oz
Chrome alum	20 grs
Water	20 ozs

The gelatine is soaked in water until quite soft and the water then poured off. Hot water is then added to make a bulk of 20 ozs. The chrome alum is dissolved separately in 2 ozs. of warm water, and the solution added a little at a time to that of the gelatine, with constant stirring. This solution is used as soon as it is made, and is applied to the paper with a soft camel hair brush giving two coatings the second after the first has been allowed to dry.

In applying the printed tissue to the single transfer paper, the first thing is to soak the latter for a short time in cold water. Five minutes soaking is usually sufficient at the end of which time the transfer paper should be quite limp. A longer soaking however must be given to transfer paper of thick substance or rough surface. In the case of these materials an hour is not too long for the preliminary soaking. It is necessary that the gelatine coating should soften and swell slightly throughout every portion of the surface and this takes longer when the paper is broken up into a series of minute depressions and elevations as it is in the case of one of rough surface.

When the transfer paper is seen to be quite limp the exposed tissue is slipped into the dish of clean water with it and allowed to remain until it straightens itself out flat. As soon as it does this slip the transfer paper under it and lift the two out of the water together with the gelatine surface of the transfer paper in contact with the dark coated side of the tissue. The two in contact are then laid upon a sheet of plate glass, a piece of rubber sheeting laid over them and a bar squeegee passed lightly but firmly two or three times each way in order to ensure perfect contact. Some little practice is necessary for this squeegeeing if too heavy pressure is given when first applying the squeegee the fact is likely to be shown by a mark across the finished print. Heavy pressure is not called for. As soon as the print is squeegeed it is placed between blotting boards and moderate pressure applied by laying a sheet of plate glass upon the boards. Ordinary blotting paper is not suitable, as it absorbs too much moisture and soon becomes pulpy. The material which should be used is the somewhat stiff board sold as "wood pulp mangles." They will outlast many sheets of ordinary blotting and are as I have said more suitable since they keep the tissue and transfer paper in a moist condition. Usually, of course a number of prints will be treated in this way at the same time and when the list of about a dozen has been squeegeed to its transfer paper that first taken in hand will be ready for development. A quarter of an hour is in fact, ample time for prints on thin transfer paper or half an hour for those on paper of stouter substance or rougher surface.

DEVELOPMENT

Perhaps the most fascinating stage in the making of carbon prints is the "development" of the picture in hot water from

the wet dark mush with which the transfer paper is seen to be coated when the original support of the tissue is stripped away. Simply soaking in moderately hot water, supplemented by laving of the print with water from the hand or a cup, speedily brings out all the detail of the picture. There is, perhaps, no operation in practical photography which so firmly retains its charm for the worker as this "development" of a carbon print.

As regards the practical arrangements for development, they will depend largely upon the means which one has at disposal. If a lavatory basin can be used fitted with a supply of hot and cold water, nothing better can be wanted for the purpose. The basin is filled with a supply of water at a temperature of from 70° to 100° F., and the heat kept up by running in more hot water as is necessary. If no such supply from taps can be had, the same method can be followed with the assistance of a good sized kettle of water, kept hot over a ring gas-burner or an oil stove, or a large metal dish, which should be at least 3 or 4 inches deep, can be kept at the required temperature by means of a small gas ring placed below it. The only other requisites are a dish of cold water and one containing a 5 per cent. solution of alum. On placing the tissue in adherence with its transfer paper into the hot water the dark gelatine coating will begin to ooze from the edges in a minute or so, and when it is seen to be softening freely in this way, a corner may be lifted to see if the backing paper will come away easily. If this corner offers any perceptible resistance to a very gentle pull, the temperature of the water requires to be somewhat hotter. In making the water hotter, either by adding hot water or raising the gas-burner, the contents of the developing dish should be stirred with the hand in order to prevent the heat from becoming localised. After a minute or two, try the corner of the print again, when it should come away easily, leaving nearly all the dark pigment coating on the transfer paper. The backing paper is thrown away and the transfer paper then laid on a glass or zinc plate and, whilst holding the latter in a sloping position in the tank, washed by letting water fall over it from the hand or from a cup. In a very short time, if the exposure has been correct, all the superfluous pigment will be washed away and the picture be seen in its finished state. It is then put to soak for a minute or two in the dish of clean cold water, then allowed to soak in the alum solution for a couple of minutes, and finally washed for about five minutes in running water.

A print which proves stubborn in development owing to over-exposure may be saved, if the exposure has not been too excessive, by leaving it to soak for a few minutes in hotter water, then repeating the laving with the hand. Another means is to add a little washing soda to the water, thereby greatly assisting the removal of the pigment coating, but rendering the latter liable to a peculiar disfigurement, resembling the grain of Morocco leather, and known as "reticulation." There is no remedy for it if it occurs on a print developed upon a paper support. If a rigid support is being used (see next page) it can sometimes be cured by immersing the plate in

methylated spirit until the granular appearance is gone, after which the print is dried without further washing or aluming. Considerable control can be exercised in developing the carbon print where the subject may require it. One such method, for example, is to remove the print from the hot water at a point considerably short of development and to finish in cold water, directing a stream from the tap upon the parts to be treated. This will carry away the semi-soluble coating whilst leaving other parts untouched. In a similar way, extra hot water from the tap may be applied to particular parts of the print which it is desired to reduce in tone. Removal of the pigment by means of a brush is a method of which some carbon printers are able to make skilful use, but it is one which, in the hands of the unskilled, can easily be the ruin of the print.

SINGLE-TRANSFER PRINTS ON OPAL.

A rigid support such as opal glass can be used in place of transfer paper, and yields results which have a very attractive appearance, and are suitable for framing close up. The sheet opal is coated on its matt surface with the chrome gelatine mixture made up according to the formula already given under "Transferring to Single-Transfer Paper." This is allowed to dry, the opal plate then soaked for a minute or two in cold water, and the exposed tissue squeezed upon it as already directed for single transfer paper.

DOUBLE-TRANSFER PRINTS.

The manipulation required in double-transfer printing is broadly the same as that already described. In place, however, of ordinary transfer paper the exposed tissue is squeezed to a temporary support, which can be either paper coated with a special varnish and sold as "temporary support for double-transfer," or may be opal glass, one side of which has been finely ground. Whichever material is used the surface is first given a coating of waxing solution, which can be purchased ready for use, or made up as follows:—

Yellow bees-wax	10 gra.
Yellow resin	10 gra.
Turpentine	1 oz.

A few drops of this preparation are rubbed over the surface of the support with a bit of soft flannel, and polished off with a soft, clean cloth. The support which has been waxed in this way is then put aside to dry for a few hours, or, better still, for a day or two. On taking sheets of opal into use for the first time two coats should be applied before using, the first being almost absorbed before the second is put on.

The waxed support, whether paper or opal, is placed to soak in cold water for about five minutes, and the exposed tissue brought into contact with it under the water exactly in the way already described for single-transfer paper. As in that case also, the tissue is squeezed down, and the two left under light pressure for from fifteen to thirty minutes. Development follows, again, exactly as

for single transfer prints, and after the alum bath and a brief rinse the prints, whether on flexible or opal supports, are put aside to dry.

TRANSFERRING TO THE FINAL SUPPORT

The special papers for the final support of prints by the double-transfer method are put to soak in cold water for a few minutes and afterwards transferred to water at about 70 deg. F, in which they should remain until the gelatine coating becomes just "slimy" to the touch. In the meantime the prints (on the temporary supports) are put to soak in tepid water until in the case of flexible supports, quite limp and free from signs of curling. The tacky transfer paper is then brought into a dish of water with the developed print upon the temporary support and the two gelatine surfaces brought together under the water. They are withdrawn together, laid upon a glass plate and lightly squeezed in contact. The whole is then hung up by a pin or clip to dry. When bone dry the final support will readily strip away from the paper or opal carrying the picture with it.

SOME FINAL HINTS

I know it is difficult to write of carbon printing without representing it as a horribly complicated succession of soakings, squeezings and strippings. Undoubtedly it is a process which from its description in print is bound to appear formidable to the beginner. It is one of those processes which one needs to be acquainted with through the medium of an actual demonstration. Then one sees the "frightfulness" of the operations replaced by the ease and smoothness with which a whole series of prints are produced with very little effort. No wonder that workers who have taken to carbon printing have become dissatisfied with any other process. I recollect some one writing a year or so ago that but for the carbon process he would have given up photography altogether.

The following hints will be found serviceable to the beginner.

Do not handle the tissue more than is absolutely necessary, and do not cut it when it is bone dry. Carefully dust each piece especially round the edges before filling in the frames.

Do not overwork the sensitising bath. As soon as it is reduced to two thirds its bulk, throw it away.

Use powdered bichromate instead of crystals, it saves time.

Remember that a strong sensitising bath, long immersion in a weaker one, or keeping the tissue a few days, tends to softness in the prints. On the other hand, a weak bath, short sensitising and fresh tissue give brilliancy.

It is not necessary to use clean water for each colour of tissue. Red chalk and engraving black can be developed side by side.

Beware of sulphurous vapours in any form. Gas stoves and coke fires are to be dreaded as the carbon printer's worst enemies.

Dark tissues print more quickly than light ones, other conditions being equal.

* Clean your finished prints with a pad of cotton wool and benzole to remove any traces of wax; motor spirit does as well and is cheaper.

For white wide margins, say cabinet on 12 by 10 paper, use the tissue the size of the negative, but mount it on a 13 by 11 support, cleaning the margins of this carefully before applying the transfer paper; do not, however, rub too hard or you will remove the wax, and the print will not separate from the support when dry.

Do not use worn out flexible support: as soon as any cracks or holes can be seen it must be discarded.

Filter, or at least strain, your elum bath and sensitising solutions each time they are used.

THE OZOBROME PROCESS.

Now I must come to a process which is carbon printing in a totally different form. The final result is a carbon print similar to that obtained by one or other of the methods already described. But it is produced in a totally different way, a way, too, which possesses many attractions, particularly to the amateur worker. There is no daylight printing; no judging exposure by actinometer; in fact, the whole of the work is done by artificial light. Moreover, the method avoids the reversal (as regards right and left), which takes place in the single transfer process of ordinary carbon printing.

This development of the carbon process is the invention (in 1905) of Mr. Thomas Manly, by whom it has been continuously improved since that time. Mr. Manly's invention was this:—He found that if a sheet of paper coated with a mixture of gelatine and pigment be soaked in a solution containing bichromate, ferricyanide, and bromide, and then squeegeed face to face with an ordinary wet bromide print, the silver image of the bromide print, in conjunction with the chemicals in which the pigmented gelatine has been soaked, produces an effect upon the gelatine which is practically the same as that produced by exposure to daylight through a negative. In other words, the starting point of carbon printing by the Ozobrome method is not a negative but a bromide print. For Ozobrome printing, the carbon tissue which is used is specially made as required by the difference in the process. In ordinary carbon printing it is necessary that light should be capable of penetrating the coating of gelatine and pigment. In an Ozobrome print there is no action of light on the tissue, but instead a chemical action of the silver image of the bromide print in the presence of the three chemicals, ferricyanide, bichromate, and bromide. In order to distinguish the special form of tissue made for the process from that used in the ordinary carbon printing, Mr. Manly calls it "pigment plaster." The solution in which the "plaster" is soaked before squeegeeing it against the bromide print he terms the "pigmenting

solution." The pigment plasters, in a large range of colours, are manufactured and supplied by Messrs. Illingworth, by whom also the chemicals for the pigmenting solution are supplied ready mixed to form the pigmenting bath.

The Ozobrome process can be worked in two ways. In Method I., the pigment plaster and the bromide print are squeegeed together and then, whilst still in contact, the two papers are placed in warm water to develop. The paper support of the plaster coating is then stripped off so that the pigment image is left on the bromide print, just as it is upon the transfer paper in ordinary carbon printing. According to this method we get one carbon print from our bromide, and we are limited as regards the effect of surface of the final result by the chance which is available among bromide papers. It should be remembered, too, that in the contact with the pigmenting bath the bromide print is bleached, just as it is in toning bromides by the sulphide method. Therefore, this bleached image requires to be removed by treating the finished carbon print in a bath of hypo and ferriocyanide which dissolves out the silver compounds. It preferred, however, the bleached silver image can be retained under the pigment image and by the application either of a developer or a bath of soda sulphide be brought to full strength again (in black or sepia tones, respectively), thus reinforcing the carbon picture. This re-development or sulphiding process is not for general application for if the process is carried out in the normal way it would give too dark a print; but it is a means of securing special effects.

According to Method II. of the Ozobrome process, the bromide print and pigment plaster are squeegeed together as before, but when the action is complete the bromide print is pulled off again and a piece of transfer paper squeegeed down in its place. This is left in contact with the pigment plaster for a few minutes, the two are put together in hot water, and the paper support of the pigment coating then stripped off as it was in Method I. Then on developing we get a print which consists of pigment only upon any transfer paper that we may select. The original bromide is released for re-development, and is used again. In this way, with care, some 8 to 10 Ozobromes may be made from one bromide.

Although Method II. sounds longer than Method I., it is in fact more speedy in practice, for the reason that there is no necessity to use a hypo bath and to remove the hypo by a final somewhat lengthy washing. Perhaps before passing to the details of the process I may set out in parallel columns the separate operations required in the two methods:—

METHOD I.

For 1 Ozobrome print on the original bromide.

1. Make a bromide print from the negative, fix, wash, harden with formaline, and wash.

METHOD II.

For 8 to 10 Ozobromes from the original bromide.

1. As Method I., but no need to harden print with formaline.

METHOD I.

For 1 Ozobrome print on the original bromide.

2. Soak pigment plaster in pigmenting bath (2 to 3 minutes)

3 Immerse soaked plaster in acid bath ($\frac{1}{2}$ minute)

4 Squeeze pigment plaster upon bromide print, and leave in contact (20 minutes)

5 Place adhering papers in warm water to develop stripping off paper backing of plaster (5 minutes).

6 Soak developed print in cold water (5 minutes)

7. Dry and then clear away underlying bleached silver image in Farmer's reducer, washing and drying.

METHOD II.

For 6 to 10 Ozobromes from the original bromide.

2 As Method I.

-

3. As Method I.

4 Squeeze bromide print upon pigment plaster and leave in contact (20 minutes)

5 Strip impressed plaster from bromide print and squeeze it upon transfer paper (1 minute)

6 Allow plaster and transfer paper to remain between blotting paper (5 minutes)

7 Develop in hot water (5 minutes)

BROMIDES FOR OZOBROME PRINTING

Although Ozobrome prints can be made from any kind of bromide yet for the best quality of results it is necessary to start with a good bromide print or enlargement of full vigour and without veil over the high lights, in other words, the kind of bromide which yields satisfactory results in sulphide toning. As regards surface the best results are obtained with platino malt bromide. There is no need for the bromide to have been freshly made; it may be years old, or, on the other hand, it may be employed as it comes from the last washing bath. The chief thing is that it should be free from veil or fog caused by faulty development, or exposure to an unsuitable dark room light. The Ozobrome worker requires to judge his bromide just as the user of any printing paper judges his negative. If there is veil over the high lights a very simple means can be taken to remove it. Soak the bromide print in water for about five minutes and then immerse it in a very weak "pigmenting bath," that is to say, in a solution made by mixing 1 oz. of the working pigmenting bath (see below) with 20 ozs. of water. Let the print remain in this weak solution only until there is the first slight indication of reducing action. The weak bath is a bleacher and shows its action on all parts of the print. But it is not easy to judge when there has been a clearing of the high-lights. As soon as the bath is seen to be having any effect at all, one may be certain that it is clearing the high-lights, and the print should then be washed for five minutes. If the action has gone too far, the print is not spoilt, for it can be re-developed and the process applied again.

Gaslight prints as a rule, serve satisfactorily in the Ozobrome

process: about the only difference is that usually they require from three to five seconds longer in the acid bath.

SOAKING PIGMENT PLASTER.

The first operation in the process is to soak the pigment plaster in the pigmenting solution and then without washing to immerse it for a few seconds in a special acid bath. After draining from this latter it is ready for squeegeeing in contact with the bromide print. The object of the acid bath is to introduce into the pigment plaster such a proportion of acid as will cause the image on the bromide print to exert an insolubilising action on the gelatine of the plaster in proportion to the amount of silver deposited. In preparing the plaster and bromide for squeegeeing together, set three dishes side by side on the working bench. That on the left should contain the pigmenting bath: that in the middle the acid bath; and that on the right plain water. The bromide print is placed in this latter and left to soak. Meanwhile, the pigment plaster, which should be slightly smaller than the bromide print, is placed coated side up in the pigmenting bath. See that it is covered by the liquid and allow it to remain only until it becomes limp. In winter this will require about three minutes: in summer, about two minutes. A camel-hair brush is useful in keeping the plaster under the surface of the bath and in dissolving any air-bubbles from the surface. If the plaster is one which, owing to its being very dry or to the nature of the paper itself, curls badly in the bath, it should be placed in, first, coated side down for a few seconds, after which it can be turned over and will lie flat.

The pigmenting solution can be used repeatedly until it becomes too thick and of brown colour, when it should be thrown away. In using old bath a rule should be made to filter it each time before use. The normal strength of the bath given in the directions for dissolving the powder pigmenting salts serves for the average run of bromide prints: if a print is of a very heavy nature, with masses of black shadows, then a stronger bath is necessary, or the back of the plaster may be painted over with a bath of ordinary strength after it has been squeegeed to the bromide print.

THE ACID BATH.

This bath is made up from the following stock solutions:—

Potash alum	...	2½ ozs.
Sulphuric acid	...	120 minims.
Water	...	40 ozs.

To make the working bath 1 oz. of this stock solution is mixed with 4 ozs. of water. The stock solution will keep indefinitely, but the working bath should be thrown away after use, and if prints to a considerable number are being made the bath should not be kept in use for more than two or three hours.

The print, which as the result of two or three minutes' immersion in the pigmenting bath has become flat and limp, is slowly raised from the pigmenting bath and placed in the acid bath, so that it

lies under the surface. The time which it remains in the acid bath for the best results depends on the character of the original bromide. If this is a weak greyish, soft print, then fifteen to twenty seconds is the proper time in the acid bath. A print of average depth and vigour requires twenty-five to thirty seconds, whilst one with extra heavy shadows should remain in the bath for thirty-five to forty five seconds, or even as long as a minute. A stop watch or stop clock which can be brought back to the starting point by a touch of the finger is a very handy means of tuning the print whilst in the acid bath. The bath itself should on no account be tampered with by adding water or doctoring it by addition of some of the stock solution. The bath is cheap enough and it is best to use plenty of it and to throw it away after it has been in use for an hour or two. Also the bath should be kept in gentle movement by rocking whilst the print is in it.

At the expiration of the number of seconds which, from the character of the original bromide, is judged suitable, the pigment plaster is removed from the bath and allowed to drain for a few minutes.

SQUEEGEEING BROMIDE AND PIGMENT PLASTER.

The bromide, being slightly larger than the pigment plaster, is laid free upon the squeegee board, which may be a good size sheet of ground glass or of hard wood, and the pigment plaster lowered upon it. In doing this, hold the pigment plaster in the right hand and carefully bring the lower edge against the left-hand end of the bromide, then steadily lower the right hand and bring the pigment plaster in contact with the bromide. Then quickly, but without any force, pass the squeegee from left to right once or twice. The two surfaces will adhere firmly and somewhat greater force can then be used in further applying the squeegee. If too much force is used at the start there is a danger of shifting the plaster from its first position of contact with the bromide, and the result of this will be a double image in the final plate. The adhering papers are then laid upon blotting-paper and allowed to remain for from 15 to 20 minutes, which latter is a time fully ample for the chemical printing to be completed.

DEVELOPING.—TISSUE ON BROMIDE.—METHOD I.

At the end of this time the print is ready for development in fairly warm water, of temperature from 160° to 108° deg. F. The water is kept at this temperature, just as in the ordinary carbon process, by means of a small ring gas-burner placed beneath. After a few seconds in the hot water the pigment is seen to be oozing from the edges of the plaster, and the paper backing of the latter can then be stripped off. After a few minutes' soaking in the warm water the picture will begin to develop, and the process can be helped by gently pouring water over the surface. Development, in fact, is almost exactly the same as in carbon printing. When fully developed the print is placed in cold water for about five minutes, and is then ready to be passed into a 10 per cent. hypo

bath to which a few drops of potass ferricyanide solution have been added—enough to make a pale yellow mixture. Here, in about ten minutes, the bleached bromide image is completely removed, and after a further washing of about a quarter of an hour the finished print is ready to be dried.

SQUEEGEEING TO TRANSFER PAPER.—METHOD II

The first three stages of the process are practically the same when following Method II. Instead, however, of laying down the pigment plaster upon the larger bromide the plaster is cut larger than the bromide, and after passing through the pigmenting and acid baths is laid face up on the squeegee board and the bromide squeegeed down upon it, the two being left in contact for about twenty minutes. The two are then separated by carefully raising one corner of the bromide print and slowly pulling it away. The print will come away easily; there will be no sticking unless the two have accidentally been left in contact for too long a time. The next step is to squeegee the pigment plaster to a sheet of transfer paper cut somewhat larger than the plaster. The conditions in the Ozobrome process are not so favourable to good adherence of the transfer paper to the plaster as in the ordinary carbon printing. The difficulties of frilling which occurred in the past have been almost entirely removed by a modified method of squeegeeing worked out by Mr. Mauly. Lay transfer paper (dry and firm up) on the squeegee board, dip a sponge in water, and squeeze the bulk of the water out again. Then damp the gelatine surface of the transfer paper with the sponge. Wait for about a minute for the paper to straighten out, and then dip the sponge again into water, and squeeze large drops on to the paper; carefully avoid wetting the back. There is no need to get the drops to fall close to the edges of the paper; so long as there are plenty of isolated drops of water resting on the paper they will serve, although they may be chiefly towards the middle. Now remove the plaster from the bromide print and quickly apply it to the transfer paper, holding it in a C-shaped loop above the centre of the transfer paper, lowering it into contact at this point, and then at each side, and immediately squeegee down firmly and place under pressure between blotters for five minutes—longer will do no harm.

At the end of this time the print is ready for developing in hot water exactly as in Method I. When fully developed it only remains to give the print a short washing (about five minutes) in running water and to place it to dry.

RE-DEVELOPING THE BROMIDE.

In making a further Ozobrome from the bromide the latter requires to be re-developed, which is done by applying any ordinary developer, such as diamidophenol or metol-hydroquinone, but without bromide. This re-development should be thorough. The image will usually come up first of a brownish colour, which speedily attains full depth and blackness. Make it a rule to

develop for a further two minutes after this stage has been reached. The re developed print is then washed for five minutes, and is then ready for squeegeeing into contact with pigment and acid treated plaster for production of a second Ozobrome.

A number of Ozobrome prints can thus be made in succession—how many depends on the strength and substance of the paper of the original bromide and on the care and skill exercised in squeegeeing in contact with the plaster. As a rule, better contact is obtained with a bar squeegee than with a roller, but the beginner should certainly start with a squeegee of the roller type, and should see that he gets a good one—one that is which has a thick covering of soft resilient rubber.

OBITUARY OF THE YEAR.

Among those whose deaths have taken place since the publication of the 1915 ALMANAC are :-

William Brooks (Mar. 24, 1915).

William Downey (July 7, 1915).

WILLIAM BROOKS

By the death of Mr. William Brooks, formerly of Reigate, Surrey, one of the few remaining links with the early days of photography has been broken. He was for many years established as a professional photographer, his work being mainly technical and scientific, but will be best remembered in connection with collodio-bromide emulsion, in which process he had few rivals. He devoted much time and labour to this process, and enjoyed a high reputation for the quality of the emulsion which he sold, as well as for the exquisite lantern slides which he produced. It may be worth mentioning that Mr. Brooks attributed much of the quality of an emulsion to the nature of the raw cotton which formed the base of the pyroxyline, this fact being established by numberless experiments with every variety of raw cotton which could be procured. Mr. Brooks was a well-known figure at the meetings of many photographic societies, where he frequently manipulated the optical lantern, his skill in this direction being considerable, as will be remembered by those who witnessed his shows at the Crystal Palace and many other important entertainments. For many years he organised the photographic section of the exhibition of the Royal Cornwall Photographic Society, which used to be quite an important event in the photographer's calendar. He was one of the earliest users of gelatine dry plates, and in 1878 produced by their means some remarkable photographs of caves at Reigate, using paraffin lamps as the source of light. He was for many years a valued contributor to the pages of the "B.J.," his articles being always of an essentially practical character.

WILLIAM DOWNEY.

Mr. William Downey was the head of the firm of W. and D. Downey, of Ebury Street, and the doyen of British professional portrait photographers. Mr. Downey, who was a native of South Shields and started in business on the Tyne, had been a photographer of Royalty for more than forty years, and since he first photographed the late Queen Victoria in the sixties he had been

in constant attendance upon the reigning monarch, and had enjoyed a degree of favour which in the case of King Edward was better described as friendship. Born in the North of England, Mr. Downey was the possessor of sound business instincts and foresight; on the advent of the picture postcard he was one of the earliest of leading professional photographers to discern its effect upon the published cabinet photograph; and in the height of the picture postcard craze he is reported to have sold two and a-half million postcards of a theatrical beauty. Of late years Mr. Downey necessarily left much of the business in the hands of other members of his family, but his picturesque figure was often to be seen in London. Until a year or two ago, on the occasion of any specially important group of Royalties being photographed, he personally supervised the arrangements. Though his long connection with portrait photography entitled him to regard himself as emphatically one of the old school, his interests were still shown in the most modern examples of photographic portraiture. At the time of his death Mr. Downey was eighty-six years of age.

Among others who have been removed by death during the past twelve months are —J. Drummond Shiels, of Edinburgh; M. Edouard Stebbing, known as "Professor Stebbing," of Paris, and J. S. Burrow, of Cumberne, all professional photographers, and the last-named a pioneer in the practice of flashlight photography underground. Among notable amateur workers who have passed away during the past year are :—Newton Gibson, J. H. Baldock of Croydon, Lewis Medland, Arthur Marshall, and G. F. Williams. Mr. Williams was one of the old school of photographic experimentalists and the author of many contributions on emulsion making and on electrical matters in the "B.J." of the last century.

In the photographic world a leading personality has been removed in the death of Mr. H. C. Zerfli, general manager of Messrs. Ilford, Limited.

EPITOME OF PROGRESS.

BY THE EDITOR.

In the following pages will be found classified abstracts of papers, communications, and articles describing progress in technical photography (art topics are excluded) which have appeared in the British and foreign Press during the twelve months October 20, 1914, to October 20, 1915.

The general arrangements of the Epitome will be seen from the contents of the ALMANAC, which follows the title-page. Each item is separately entered in the index at the end of the volume, and a list of the journals abstracted will be found at the conclusion of the Epitome.

In a number of cases where information additional to that in the abstract has appeared in the "British Journal of Photography," a reference to issue and page has been given.

I.—GENERAL

EVENTS OF THE YEAR 1915.

July 23 —Under the auspices of the Y.M.C.A. the services of amateur and professional photographers have been largely organised for the purpose of sending to soldiers and sailors engaged in the war at home and abroad photographs of their folk at home. ("B.J." July 23, 1915, p. 475.)

Aug. 23 to Oct. 2.—Sixtieth Exhibition of the Royal Photographic Society, held at the Galleries of the Royal Society of British Artists, Suffolk Street, Haymarket. ("B.J." Aug. 27, 1915, p. 555.) Selecting and Hanging Committees:—Pictorial section: A. L. Coburn, J. H. Gear, Furley Lewis, J. C. S. Mummery. Colour transparencies: J. H. Gear and H. E. Corke. Scientific and technical: Chapman Jones, R. Kearton, F. Martin-Duncan, C. E. K. Mees, and J. W. Ogilvie.

Sep. 18 to Oct. 16.—Sixth Exhibition of the London Salon of Photography. Held at 5a, Pall Mall East, S.W. ("B.J." Sep. 24, p. 620.)

Oct. 12.—Eighteenth Traill Taylor Memorial Lecture. By Frederick J. Cheshire on "The Modern Range-Finder."—"Phot. Journ.," November, 1915, p. 250.

BUSINESS.

Houghton-Butcher Manufacturing Co., Ltd.—This company was registered in January, 1915, to take over those parts of the businesses carried on by Messrs. Houghtons, Ltd., and Messrs. W. Butcher and Sons, Ltd., which relate to the manufacture of cameras, etc., as distinct from the selling and marketing of goods. Capital, £70,000, in £1 shares, £69,000 preference and £1,000 ordinary. The first directors are E. W. Houghton, W. F. Butcher, F. W. Thompson, F. E. Butcher, I. Joseph, C. E. Houghton, G. A. Spratt and H. J. Spratt.—"B.J.," Jan. 22, 1915, p. 49.

Assistants' Specimens. In a police court case at Southend, Essex a photographic operator was charged with the theft of 24½ dozen photographs and one enlargement from the establishment of his employer, for whom he had been sole operator. The defence was that such an assistant was entitled to take specimens of his work for his own use in obtaining situations in the future. The defendant advanced this as the custom of the trade, and in excuse of the number taken he pleaded the constant loss of specimens owing to their non return by employers to whom they might be sent. The defendant was discharged by the magistrates. "B.J." October 1, 1915, p. 642.

II. - APPARATUS AND EQUIPMENT.

(Including Raw Material Used in Photography)

The many details of pieces of apparatus published chiefly in patent specifications are not abstracted in this Epitome as space does not permit of the numerous drawings necessary for their explanation. All patent specifications are abstracted in the 'British Journal of Photography' and are entered according to subject and also under the name of the patentee in the index to the yearly volume of that publication which is issued with the last number of the year or the first of the year following.

Dark Room and Studio

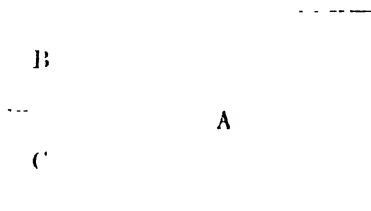
Mending Washing Tanks. In default of means for soldering a leaking washing tank a little marine glue will make an effective seal provided that the tank is used as it generally is, only for cold liquids. The marine glue is melted without actually burning by heat, as one uses sealing wax, and dropped on the affected part, it is then worked into a hole or crack, for instance with the aid of a stout knitting needle or old knife blade made hot in a gas or candle flame. A.P., July 19 1915 p. 52

Temporary Safe Light. Two thicknesses of white blotting paper stained with ordinary red ink and when dry washed with a little melted candle wax make a red light which, if not equal to a real 'safe light' forms an excellent temporary substitute for plate changing etc. If the more orthodox screen is not to be obtained - Phot. May 18 1915 p. 371

Dark Room Safelights. H. Hurlidge has patented a method of producing dark room safelights which, whilst affording a safe illumination nevertheless provides one which has the characteristics of white light. The principle of the method is the simultaneous use of two filters, each of which is safe for photographic purposes, whilst each is complementary to the other, thus affording a transmitted light which is free from colour. One example of this principle is the use of a red screen passing light from 730 to 685 in conjunction with a green screen transmitting from 540 to 515. In this case the colours are not quite complementary and the resulting light is a pale rose colour. A better combination consists of a filter passing

red from 680 to 590 with one transmitting green from 570 to 530. This yields light of a pale cream colour. The dyes used for the purpose are victoria blue, naphthalene green, mandarin orange, and filter yellow K. If the victoria blue be omitted the transmitted spectrum is from 680 to 530, yielding a very bright yellow, but safe, light. The above filters are for use with ordinary plates; for colour-sensitive plates it is necessary to use additional filters.—Eng. Pat. No. 17,789, 1914. "B.J.," Sept. 10, 1915, p. 593.

Scientific Plate-Washer. W. L. Fox describes a design of plate-washer which appears to embody in an excellent way the features which this piece of apparatus should possess. These features are: (1) The plates remain covered with water for some considerable time after the water has reached their upper edges; and (2) the water is very rapidly drawn off each time after the plate tank has filled. This action is obtained by a mechanical device of a very simple kind. The tank is made with three divisions, which we may represent in plan roughly, thus:—



A contains the plates in the usual form of grooved rack. The tank is stool under a tap so that water runs into A. The water overflows through a division which separates A from B and C, passing into a metal box which hangs in C. It hangs there from a pivoted balance arm, to the opposite end of which is suspended a heavy plug, resting on a wide aperture on the floor of division B. On water flowing into the box, the latter falls, thereby raising the plug and emptying the washer, since tank A communicates by a channel with the space immediately above the plug. The metal box in C has a few fine holes punched in it so that the water escapes from it whilst the plate space A is emptying. With the metal box emptied the plug in B falls again and the series of operations starts afresh.—"Photo Era," July, 1915, p. 17.

An Electric Plate Rocker.—P. W. F. Brown gives the following drawings and working details for the construction of an electric rocking apparatus.

A piece of board 8 ins. square has fixed on one face a piece of wood 12 ins. by $\frac{1}{2}$ in. by $\frac{1}{4}$ in. parallel to one side and passing through the middle of the board. Attached to this is another

piece 3 ft. by $\frac{1}{2}$ in. by $\frac{1}{2}$ in., with an old clock weight wired on to the extremity. An old electric bell is now stripped of its gong, the

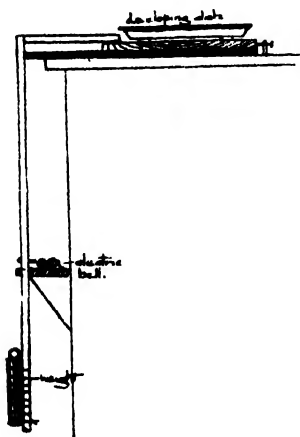


Fig. 1.

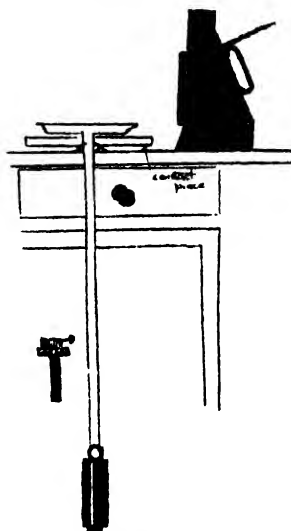


Fig. 2.

make and break and wired straight to the magnets. A contact piece is made as per diagram No. 4 and placed below the board on the right-hand side. The whole is wired as in fig. 5.

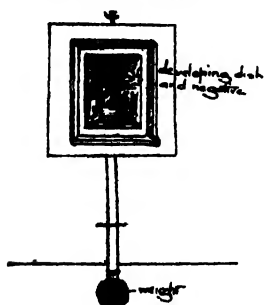


Fig. 3.

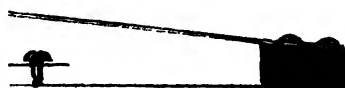


Fig. 4.

On the switch being turned on and the pendulum given a slight push to the left, contact is made between the brass strip and the

screw; the current flows and the bell hammer hits the pendulum just as it is about to swing back, thus helping it on. This is repeated ad infinitum.

The apparatus is found useful in making warm-toned

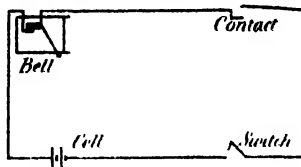
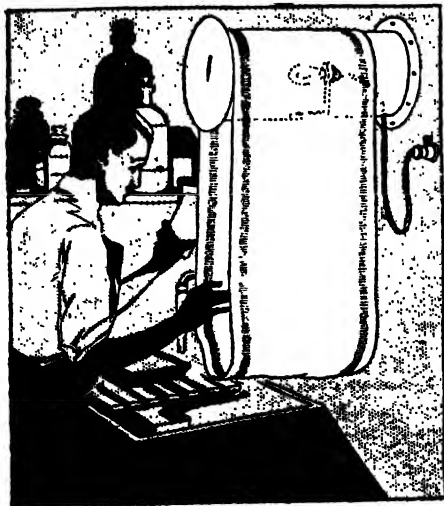


Fig. 5.

lantern-slides by restrained development. It will run for hours without attention. In factorial development it is useful since the swing of the pendulum can be taken as one second.—"B.J.," October 1, 1915, p. 645.

Towel-Drier for the Dark-Room—A writer in "Popular Mechanics" has described the device shown in the drawing for keeping the dark-room towel constantly dry. It consists of a gal



vanised iron pipe about 2 ft. long and 8 ins. diameter, with a metal disc about 10 in. diameter soldered to each end to form a flange. The drier is screwed to the wall by one flange and an electric lamp arranged within the pipe. The heat from the lamp serves to warm

about a 12-in. length of the towel, so that by moving the towel round from time to time it is kept continuously dry.—“B.J.,” October 8, 1915, p. 661.

A Pendulum Rocker.—Alb. Kapteyn has described the construction of a pendulum rocker designed by him for use in the dark-room. The rocker is capable of keeping a 12 by 10 dish containing 35 ozs. of developer in steady movement for $1\frac{1}{2}$ hours without attention. This result is secured by using the force of gravity to drive the pendulum. A weight K is suspended from the ceiling and its string runs over the pulleys *a*, *b*, and *c* to a barrel L, of which the spindle is coupled to a pair of wheels and pinions, so as to revolve the pinion Q and the crank R in the direction of the arrow. The crank-pin is connected by means of the bent rod S to the point T of the oscillating table I, of the pendulum apparatus. The front elevation of the combined apparatus is illustrated by the united figures 4 and 1. The operation is quite simple. When the crank R rises the connector S pushes the point T upwards, but cannot do this unless the pendulum is set swinging. At the upper limit of its stroke the crank passes the dead point and then it pulls the point T downward. This lifting and pulling of the rod S keeps the pendulum moving. The bent shape of the rod S is necessary, because we have here really two machines at work—viz., a pendulum and a motor. The crank-pin has a constant stroke, but the pendulum and the point T of its table has a variable stroke (depending upon its swing). It is therefore necessary to couple these two unequal motions by an elastic connector. As a matter of fact, the rod shown is a stout knitting needle, which bends to the right and to the left when it transmits the push and pull of the crank-pin to the point T. There is another point of importance. For small dishes the power of the motor is too great and tends gradually to increase the swing of the pendulum, until it is too much for the accommodation which the connector can give, and there may be rupture of some part or other. To prevent this, blocks of wood V (Figs. 1 and 2) were fastened to the baseboard E and thin wooden laths U nailed against them, to fill the office of retarding springs when the swing of the pendulum increases too much. This effectually gets over the difficulty, and the pendulum now keeps practically the same swing, whether it runs empty or with the heaviest dish.

The apparatus is now complete. Actual trial showed that a dish for 12 by 10 plate, with one litre (35 ozs.) of fluid, is kept rocking for $1\frac{1}{2}$ hours without attention.

One point remained to be dealt with. The apparatus gave a powerful knock and hammered the seconds audibly all over the house. The reason for this knock lay, no doubt, in the play there was in the wheels, axles, and bearings of the train of clockwork, which were taken from an old alarm clock. Suppose this play to be one millimetre at the crank-pin, then, as drawn in Fig. 3a, there is no resistance when the crank moves from R₁ to R₂. Consequently it arrives at the latter point with a blow, and has to stop there until the pendulum has reached the limit of its stroke and enters upon its return journey. The crank-pin can then pro-

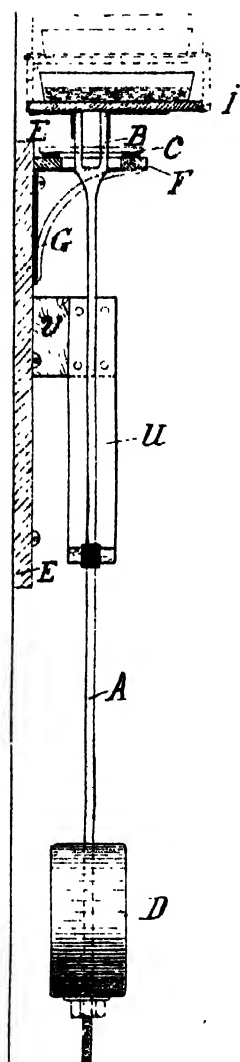


Fig. 2.

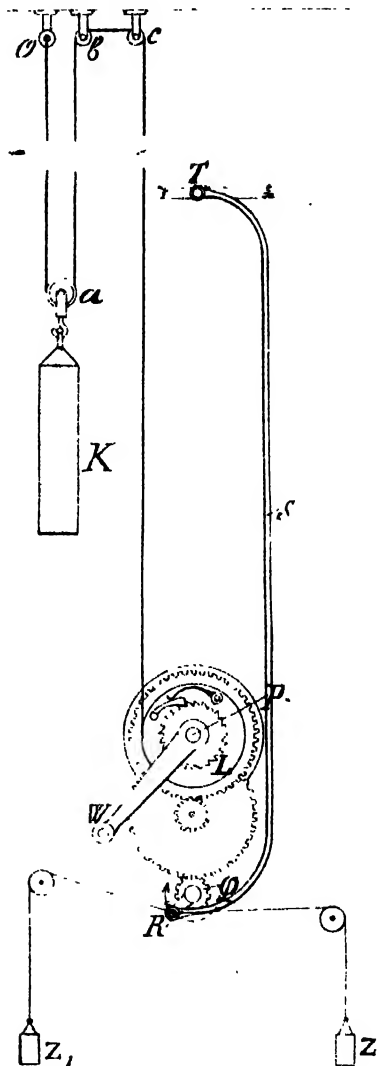
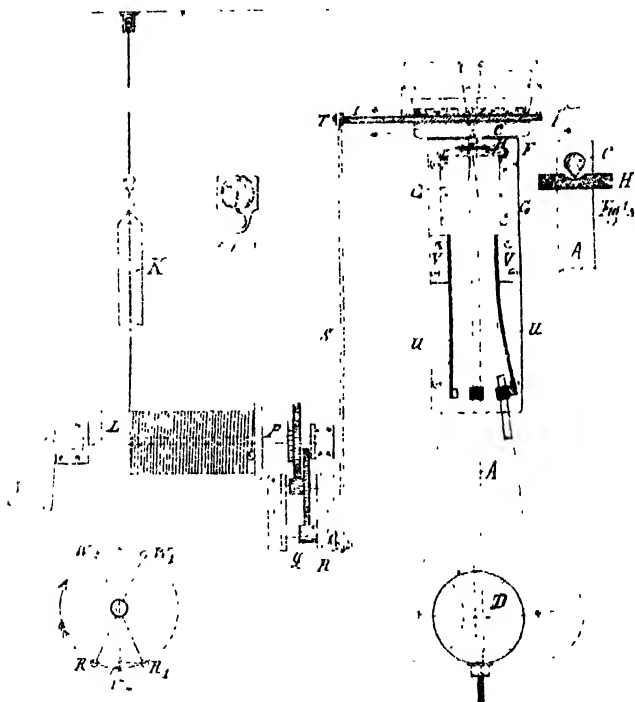


Fig. 3.

ceed upward, and knocks again when flying from W to W_1 . These objectionable knocks are therefore caused by the acceleration of the crank between R_1 and R as well as between W and W_1 . If now we can manage to give the motor at these points some other work to do, by giving it another mass to accelerate, then the crank-pin will arrive in R with greatly reduced speed and the noise will also be reduced.



To carry out this idea two small weights Z and Z' were suspended by means of strings and pulleys from the crank-pin R . These small weights balance each other, and therefore have no influence on the movement. It is quite remarkable what small weights will stop the noise of the apparatus. With 100 grammes each, the beat of the seconds can only faintly be heard when standing near, and with 25 per cent. more the noise disappears practically altogether. This, however, is not desirable, because it is a great comfort to have the seconds whispered at your ear when commencing development. As regards the weight K which is used, this is an old

oxygen cylinder, weighing about 30 lbs., and it may be of value to add that the apparatus has been at work almost daily for over a year, showing no wear of any sort, and consequently there can be no question as to its efficiency.—“B.J.,” March 19, 1915, p. 189.

Studio.

Painting Backgrounds. J. L. Sullivan, writing as the result of many years' professional experience in painting backgrounds, gives particulars of the tools and colours which he considers best, together with hints on the manipulation in painting the grounds. The brushes required are as follows:—

- Two 4-in. brushes. Best long stock Russian white bristle.
- Two 3-in. wall brushes. Best long stock Russian white bristle.
- Four 2-in. chisel brushes. Best short stock Russian white bristle.
- Two No. 6 artist's bristle, round black polished handles.
- Two No. 6 artist's bristle, flat black polished handles.

These are supplied by Messrs. Gerts, Lombard and Co., Chicago, Ill., U.S.A.

A straight edge of 5 ft. length and $1\frac{1}{2}$ inch width is also required. Brown unbleached sheeting of 8 ft. width is obtainable from any large drapery store. The colours, etc., for painting the grounds are as follows:—

- 25 lbs. of English clifstone Paris white.
- 15 lbs. of English ivory drop black.
- 5 lbs. of American ochre.
- 5 lbs. of American raw umber.
- 5 lbs. of American scene-painters' gelatine.

Six pails for colour, etc., are provided, and should be arranged as here shown:—

0	0	0	0	0	0
White.	No. 1.	No. 2.	Wall-colour.	No. 3.	No. 4.

The white is made by filling the pail about two-thirds full of water then *slowly* dropping in enough white to absorb nearly all the water. On well stirring up, the mixture should be a thick paste. A similar pail is made up but using ivory drop black in place of the white. This is No. 4.

For preparing Nos. 1, 2, and 3, and the wall colour mixture, we first make up a pail of raw umber and ochre, a pail of each, also a gelatine mixture made by filling a pail with gelatine to within an inch of the top, filling with water, standing six hours at least to soften and then melting by placing in another and larger pail containing hot water. This gelatine solution is added to each of the four colour mixtures already made in order to size them properly. This is tested by letting the colour dry on a piece of paper: it should not rub off. But care must be taken not to add too much gelatine or the ground will crack and be useless. About 1 pint of gelatine will size about a gallon of the white paint: from 1 to 2 pints gelatine for the black, ochre or raw umber.

The colours so mixed should be of the consistency of very thick cream.

To make now the working mixtures, a very little raw umber is first added to the black (No. 4), just enough to take the bluish cast off, and to give a rich warm black.

The wall colour mixture is made enough of the white and red black (No. 4), equal parts of each, to fill the pail about half full.

The No. 3 is made up by taking one third wall colour and two-thirds red black (No. 4).

The No. 1 consists of the white that remains with just a little of the wall colour added.

The No. 2 is made by taking equal parts of No. 1 and wall colour.

A second lot of white should be mixed up for putting in ground work, etc.

The tinted mixtures Nos. 1, 2 wall colour, and No. 3 are still raw. A little ochre and red umber are stirred into each in order to tone them. The quantity depends on the result required in the ground. For sepia umber only is used, but for medium warm tone, both ochre and umber. This toning up gives the full six colours running from white to red black. Tints look much darker in the pails and on the canvas than they will look when dry. This must be allowed for or ground will be much lighter than intended.

If your colour chills (jells), warm it on the stove, and if it is still too thick to flow well from the brushes thin it with a size made from one part of gelatine and seven parts of water. Be careful not to add too much, or your colour will become so thin that it will run on the canvas, and you will be unable to have your drawing with the brushes stay where you put it.

Stretch your canvas (stretching is called canvas by background painters) by tacking the selvage edges first, i.e., after you have tacked each corner. Place the tacks about 5 or 6 ins. apart. Stretch the canvas until it is taut and all creases and wrinkles have disappeared.

You are now ready to draw in the design you are about to paint. Do this with soft artist's charcoal. Sketch in the design carefully and if you find any oil spots on the canvas, cut them by applying benzine and brushing them thoroughly with one of the No. 6 brushes. The oil will look yellow, and must so be treated or it will stain the paint when it dries.

If you desire a ground of light tint, you will use tint No. 1 and white for the broad masses and with tint No. 2 for the delicate clouding, and here and there in the deeper shadows a touch of wall colour. The colours are applied directly to the canvas without other preparation than a given save for cutting the oil stains with benzine.

Half tones are obtained by mixing the different colours as you apply them to the canvas, and by blending them with the brushes.

Use the large brushes for laying on the body colour and blending. The artists brushes (No. 6) are used to put in the "cut up" or detail.

To obtain a medium ground use tints No. 2 wall colour, and No. 3 for the broad masses, and No. 1 and white for the high contrasts in windows, doors, etc. No. 4 (red black) is used for the

dark accents of detail, and is rarely used in the "lay in," except in very dark grounds, when it is used where you would use tint No. 3 in painting a medium tint ground.

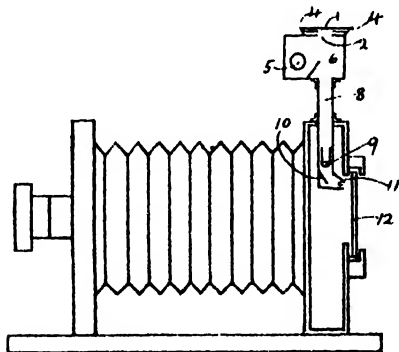
Choose a simple design for your first effort.

Be careful not to allow the colour to dry or "set" anywhere, except on the edge of a doorway, window, or prominent curtain.

Lay in the centre of the ground first, then the sides. If the colour at the sides of the centre has set or dried, wet the edges with clean water, and you will be able to blend in the colour sufficiently at the point of union.

After you have laid in the whole ground, or such parts of it as seem advisable, your experience and skill as an artist will suggest putting in as much of the detail as possible. Unless you are experienced, this had better be left until the whole ground is thoroughly dry, when you can do it leisurely. This is done with the No. 6 brushes of your equipment. "Wilson's," Nov. 1914, p. 485; "B.J.," Dec. 11 1914, p. 900.

Studio Numbering Camera. H. Woolfe has patented an attachment for fitting to a studio camera by means of which the number upon a ticket handed to the sitter on his entering the establishment may be photographically impressed upon the plate used for



the taking of his portrait. The ticket is inserted in a small illuminating chamber, "1," where it is illuminated by an electric lamp, "5," and an image of it formed on the plate by means of the lens, "9," and the mirror, "10." Eng. Pat. No. 22,380, 1913; "B.J.," Nov. 27, 1914, p. 874.

A Studio-Camera Fitment.—L. Chapman mentions the usefulness of fitting a 6-in. length of $\frac{1}{4}$ -in. composition pipe into the bottom right-hand corner of the front, so that the end of the pipe is flush with the front. The length of the pipe is inside the camera, and is bent sharply as soon as it enters so as to lie along the bottom close to the front. The inside of the pipe is coated with dead black

varnish by filling and emptying it. This pipe serves a two-fold purpose: it lets air pass freely in and out of the camera when it is being opened or closed, so that the bellows are not sucked in or distended, and it also allows the introduction of an "Antinous" release for an inside shutter of the flap type. This size of pipe, bent and blacked as described, will be found to be perfectly light-tight. "Phot.", August 31, 1915, p. 150

Studio Shutters—Where a studio shutter of the flap or bellows type fails to open or close exactly with the movement of the hand upon the pneumatic bulb, except by very hard and sudden pressure, it will generally be found that there is an unnecessarily large space in which the rubber bellows has to expand before it exerts any appreciable pressure on the moving parts. Not only does this mean that the shutter will not start to open till the ball is half compressed but it also has the effect that the rubber leaf is doing the

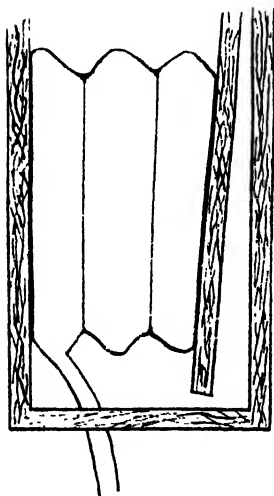


Fig. 1.

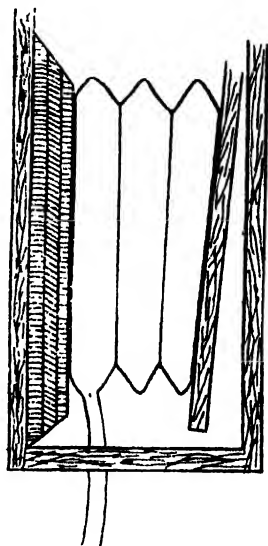


Fig. 2.

hardest work when it is fully expanded, as indicated in Fig. 1, with great consequent strain on the seams. It is the work of a very few minutes to ascertain how far the bellows expands before the shutter commences to open. If this space is then filled in with a bit of three-ply or cardboard (Fig. 2) the shutter will be found to "answer the helm" much more smartly and with less pressure on the ball, but at the same time the leaf will never be fully ex-

tended and the strain on it will be greatly reduced in consequence, so that it will last a good deal longer—"B J," May 21, 1915 p 335

Half Watt Lamps In a paper (before the Illuminating Engineering Society, New York) M. Luckiesh has dealt exhaustively with the photographic use of half watt lamps as regards the suitability of the light emitted by them for photographic work on ordinary and orthochromatic plates. He has given drawings showing the broad outlines of fixtures for the lamps in portrait studios and has shown some of the convenient commercial patterns of reflectors and lamp standards. B J May 7 p 303 May 14 p 317 and May 21 p 333 1915

Waterproof Lorry Shave In exceptionally persistent wet weather outside lorry-cases which become leaky are best treated by covering the whole case with a strong waterproof fabric such as tarpaulin fitted as neatly as possible with good overlaps where the joints of doors or loose panels occur. The thin asphaltic roofing felt is very durable and if warmed at the bends may be fitted much more closely than would be imagined by anyone who has not tried it. For lead round the glass a stopping composed of white and red lead mixed with linseed oil will be found very effective. By mixing a little black with it a fair match for mahogany or walnut may be obtained while for chrome used once a touch of black enamel applied with a worn-out spotting brush will make things look decent again. A cheap watertight case may be made of an ordinary frame having a sheet of zinc for a backboard and binding this the glass and the board on which the specimens are mounted all together like a lantern slide using the well known india-rubber plaster such as is used for sealing plate and film boxes for export. Such a case is not merely waterproof but is damp proof as well and is very useful for railway stations and similar positions. B J Jan 1st 1915 p 35

Lenses and Photographic Optics.

Anastigmat Lens J. Stuart and J. W. Hasselkus have patented a type of large aperture anastigmat lens. It consists of a lens combination of two dissimilar kinds separated by the diaphragm the front combination consisting of a plano-convex lens (or a double convex lens) separated by an air space from a double concave lens the air space being in the form of a positive lens (a meniscus when the first named lens is double convex) and the back combination consisting of three lenses cemented together, the first lens being a double concave or plano-concave lens of low refraction the second lens being a meniscus lens of medium refraction, and the third lens being a double convex lens of high refraction.

The gradual increase in the refractive indices in the lenses of the back combination enables the curvatures and thicknesses of the lenses to be so determined that the spherical, astigmatic, comatal and zonal aberrations become a minimum for this type of lens—Eng. Pat. No. 29,637, 1913, "B J," Nov. 27 1914. p 874.

Separable Large Aperture Anastigmat Lenses.—J. Stuart and J. W. Hasselkus have patented a type of construction of lens in which each component is separately corrected, may be of considerably different focal length, and work at a larger aperture than hitherto in this type of instrument. For the double concave lens a glass is used having as nearly as possible the refractive index and dispersion of fluor spar—namely, fluor crown glass of Dr. E. Zschimmer, Jena.

The objective, if used as a single element, is constructed by cementing together four lenses of varying refractive indices, the first lens (that is, the lens nearest to the diaphragm) being a double concave lens, and being made of the glass of the aforesaid kind, which has a very low refractive index and very low dispersion. The second lens is made of crown glass of high refraction, the third lens being a meniscus of medium refraction, and the fourth lens being made of flint glass of high refraction.

In the objective thus made the first and second cemented surfaces are collective and the third cemented surface is dispersive, and the first cemented surface, which has its convexity turned towards the diaphragm, contains a λ difference between the glasses of the first and second lens of at least 0.1, whilst the difference in the n values is at least 9.0, owing to the use of glass of the aforesaid kind for the first lens. Objectives made according to this invention are corrected perfectly for spherical, anastigmatic, chromatic, and comatal aberrations, whether they be used singly or combined. Eng. Pat. No. 29,636, 1913; "B.J." Jan. 29, 1915. p. 72.

Large Aperture Anastigmat Lenses.—H. L. Aldis has patented a construction of anastigmat lens (having an aperture of from $f/5.6$ to $f/4$), in which four simple lenses are used. The front lens is a cemented combination, consisting of a double convex positive lens of high refractive index (approximately 1.62) cemented to a nearly plano-concave negative lens of low refractive index (approximately 1.52), the positive lens being placed outside. Close to this, and separated from it by a small air space, is placed a double concave negative lens, the refractive index of which may vary considerably, e.g., from about 1.56 to 1.63.

Behind these two lenses, and separated from them by a considerable interval (at least twice the air space above mentioned), there is arranged a positive lens formed of optical glass of a high refractive index (approximately 1.60). This positive lens is in shape nearly plano-convex, the more strongly curved surface being placed outside. The exact distance of this positive lens behind the front combination detailed above is determined by the corrections for distortion. If the distance is too great, the whole lens will show barrel-shape distortion, and if the distance is too small the lens as a whole will show pin-cushion distortion, there being a definite intermediate position for this lens, in which the lens as a whole is completely free from marginal distortion.

Any convenient stop may be arranged between the two last-mentioned lenses.

Although the cemented combination above referred to is described,

as the front lens, the system may be reversed, in which case the cemented combination is at the rear of the lens. For curves and numerical data of the glasses the Patent Specification (No. 13,119, 1914) should be consulted in "B.J." July 9, 1915, p. 451.

Measuring Focal Length - A Lockett has described a novel method of measuring the focal length of a lens in which it is only necessary to focus for infinity, to mark the position of the lens-front on the baseboard, and to set off two equal distances on the focussing-screen, and on the base-board, respectively, commencing in the latter case from the infinity mark. There are no calculations and no

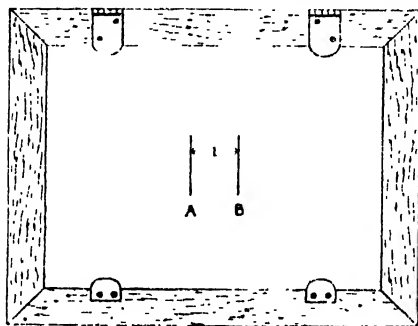


Fig. 1.

actual measurements of distances other than the setting off of two equal distances, one on the ground glass and the other on the base-board.

First draw two short vertical pencil lines at about the centre of the focussing screen, exactly 1 in. apart and parallel with each other, as at A and B in Fig. 1. Focus sharply with the full aperture of the lens on a far-distant object, such as a remote church spire or factory chimney, and mark carefully on the camera base-board the exact position of any convenient part of the moving lens front, or, if a pointer is fitted, mark the position of that. Measure off 1 in. in advance of the "infinity" mark so obtained, make a second mark, and rack out the camera till the front or pointer is against it. Lastly, fix up a foot rule horizontally at about the height of the lens, with the figures upside down, and move the whole camera to and fro, without any other adjustment, until the rule is in the sharpest possible focus at full aperture, and with the commencement or zero of the graduations coinciding with the left-hand pencil line, as shown by Fig. 2. Then the number of inches of the rule seen between the two pencil lines will be equal to the focal length of the lens. In other words, the exact focal length is automatically recorded on the ground glass. Thus, in Fig. 2 it will be noted that $7\frac{1}{2}$ ins. of the rule fall between the two pencil lines, indicating that the lens is of $7\frac{1}{2}$ -in. focus.

If a long bench is unavailable the most convenient procedure is to fix the rule to a wall with drawing pins, and to set up the camera on a small table. The rule is then got roughly in focus by moving the table with the camera, and is finally sharply focussed by pushing the whole camera to or fro over the table. Care must be taken that the camera is properly square with the rule, and that both the camera back and the wall, easel, or other support for the rule are vertical. It greatly facilitates exact focussing if the rule is of white cardboard with black divisions and extra large figures. The worker can readily make one of this description for himself by accurately copying the graduations from an ordinary boxwood or ivory rule, but increasing the size of the figures. For lenses over 12 in. focus a 2 ft. or 3 ft. rule will, of course, be necessary.

Those to whom the rationale of the foregoing method is not quite evident may assure themselves of its exactness by the following formulæ:—Let F = principal focus and R = ratio, or proportion

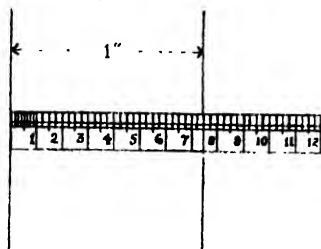


Fig 2.

between the size of the image and that of the object. Then the minor conjugate or distance from lens to ground glass = $F \cdot \frac{F}{R}$. When we mark off and set the camera front to 1 in. from the infinity mark, then $\frac{F}{R} = 1$ in. But if $\frac{F}{R} = 1$ in., $\frac{F}{R}$ must also = $\frac{F}{R}$, and, therefore, R must = F . Under such conditions, returning to the example previously given, if we get $7\frac{1}{2}$ ins. of a foot rule within a space of 1 in. on the ground glass, the ratio is obviously $7\frac{1}{2}$, and as $R = F$, $7\frac{1}{2}$ ins. is the focal length.

There is, perhaps, some risk of magnifying any slight inaccuracy that occurs in measuring off so short a distance as 1 in. on the baseboard and the ground glass, though in nine cases out of ten the effect would be insignificant for practical purposes. A greater distance would eliminate, or, at any rate, considerably reduce, the chance of mechanical or optical error. Fortunately, the above principle can be applied in just the same way by measuring off any increased distance on the baseboard and making the pencilled lines on the focussing screen an identical distance apart. For example, if we mark off 5 ins. on the baseboard from the infinity mark and make

the pencilled lines on the screen also 5 ins apart, then, on setting the camera front to the 5 in mark and moving the whole apparatus to and fro till the rule is sharply focussed, the focal length will be registered between the pencilled lines. Provided the two marked distances are kept alike, they may be of any desired length—the greater the better—the only limits being the size of the focussing screen and the length of the baseboard or extension. B J, "June 25, 1915, p. 411

Finding Focal Length. A little known method of measuring the focal length of a lens is the following. Suppose we photograph the same object twice, on different scales, and then measure the difference in size between the two images, and also the difference in the two camera extensions. The ratio of the first dimension to the original object is then the ratio of the second dimension to the focal length. For example, if we photograph a foot rule twice, getting a four inch image on the one occasion and an eight inch image on the other, the difference in the two images is four inches, or one third of the size of the object, therefore the focal length is three times the difference in the two camera extensions. If the difference in the camera extensions is six 1 2 3 inches, then this multiplied by 3 gives 5 inches as the focal length. B J (then The Camera) Sept 17, 1915, p. 602

Measuring Focal Length of Doublets. In a paper before the Physical Society, Mr. J. Smith, of the National Physical Laboratory, described a method of measuring the focal length of a lens based on the focussing of the image of a distant object on the lens axis upon the ground glass of the camera using first the complete lens and then each component separately. A further focussing is done with the two components at a different separation, this observation serving to determine the focal length of such component.

The optical rule which serves as a basis of the method is that the focus of a lens of focal length f is at a distance equal to

$$fF$$

$$f$$

from that of the combination of focal length F formed by placing in front of the first lens another of focal length f' .

The method is carried out as follows.—Fit the complete lens to the camera and focus sharply on a distant object. Mark the position of some part of the lens front or moving baseboard against a mark on the fixed part of the camera. Now remove the front component, and without disturbing the rest of the lens again focus on the object, noting the distance (f) through which the lens front requires to be racked out. The distance as already stated is

$$fF$$

$$f'$$

where F is the focal length of the whole lens and f and f' those of the components.

Now focus again with the whole lens on the object, but with the lens placed the other way about on the front, i.e., with the back component to the front. Mark the position as before, and then re-focus after removing the component (really the back combination) now in front. The distance (d') between the two positions is

$$\frac{f'F}{f}$$

$$\text{or } dd' = F^2$$

that is to say, by multiplying the distances d and d' together and extracting the square root we get the focal length.

Mr. Smith proceeded to show the application of the method to finding the focal length of each separate component of a doublet by increasing the separation of the component lenses by a known amount t . Let the two components be separated by this further distance of t . Then focus on a distant object, first with the complete altered lens and then with the back combination alone, the distance between these two foci being d'' .

$$\text{Then } \frac{1}{F} - \frac{1}{F'} = \frac{t}{ff'}$$

(where F' is the focal length of the altered whole lens)

$$\text{and } d'' = \frac{fF'}{f'}$$

From these two last equations and the first given in the paper,

$$f' \left(\frac{1}{d} - \frac{1}{d''} \right) = t$$

from which the focal length of the back component can be found. That of the front component can then be found from the equation

$$\frac{t}{f'} = \sqrt{\frac{d}{d''}}$$

—“B.J.,” July 23, 1915, p. 482.

TELEPHOTO LENSES, ETC.

A Telephoto Lens-Hood.—Captain Owen Wheeler has patented a lens-hood consisting of a quite short length of tube containing an iris diaphragm. The attachment can be fitted to the front of a telephoto lens, and the screening of the latter from extraneous light may be done by using the diaphragm of various apertures according to the magnification at which the telephoto lens itself is employed. Eng. Pat. No. 20,043, 1913 —“B.J.,” Oct. 23, 1914, p. 793.

Large-Aperture Telephoto Lenses.—L. B. Booth has patented a form of construction for telephoto lenses yielding definition over a comparatively wide field and working at a relatively large aperture. Four lenses only are used. These are divided into two groups of two, separated by an interval containing the diaphragm, and in the mounting of the system this interval may, if necessary, be made variable. One of these groups consists of two lenses enclosing an air space between their two facing surfaces, and the other group consists of two lenses in contact and cemented together. The power of the two facing surfaces in the one group is negative; whilst the power of the cemented surface is, for the ray D of the solar spectrum, either negative or substantially equal to zero—in other words, the cemented surface must either have a dispersive effect, or its collective effect must be wholly inappreciable. Eng. Pat. No. 5,096, 1914. "B.J.," Dec. 4, 1914, p. 890.

Large Aperture Telephoto Lenses. C. F. Ian Davis has patented the construction of a large aperture lens either of fixed or variable focal length, in which the focal length of the front and back combination are of opposite sign, the focal length of the negative being about equal to, or greater than, that of the positive. The indices of the front crown and flint have been varied within wide limits. The positive crown should preferably be made of glass of high refractive index, and the flint, of glass of equal, or less, refractive index, but different dispersion. The negative may be made either with the flint, of glass of high refractive index and high dispersion, and the crown, of glass of low refractive index and medium dispersion, or with the flint and crown, of glass of approximately equal refractive index, or with the index of the glass for the flint less than the index of the glass for the crown.

The novelty of the invention lies in the attainment of simple large aperture lenses working at $f/4.5$ and larger, coupled with reasonable freedom from spherical aberration, coma, astigmatism, distortion, and chromatic aberrations.

The positive may consist of a cemented doublet, the refractive indices for D of the two glasses composing it being approximately equal, but the dispersions being different. In this way an achromatic front combination is formed with considerable remaining spherical aberration. Behind this is placed the negative lens consisting of three cemented lenses, which combination is also approximately achromatic. By the use in the negative of glass of high refractive index for the two exterior lenses, and of glass of low refractive index for the interior lens, it is possible finally to construct a large aperture fixed-focus telephoto lens, well corrected as a whole for spherical aberration and coma, chromatic aberrations of position and magnification, astigmatism and curvature of field up to an angle of 15 degrees measured at the centre of the stop midway between the combinations.

Particulars of the curves and of the physical properties of the glasses are given in the Patent Specification (No. 1,185, 1914, "B.J.," April 23, 1915, p. 273).

Cameras and Accessories.

Cameras for the Tropics.—G. J. Stokes, writing from Ceylon, gives his experience as a maker for many years of photographic apparatus in the tropics. As regards aluminium, he finds that the material itself does not suffer in tropical conditions, but that the aluminium parts of cameras almost invariably decay, apparently as the result of the action of the adhesive by which leather or other covering is affixed to the aluminium. Also some aluminium alloys suffer much sooner than the pure metal. Alloys which do not readily deteriorate are "Magnalium" and "Duralumin," the latter the very strong and light metal supplied by Messrs. Vickers. Iron and steel parts are extremely liable to rust, and, wherever possible, should be given a protective coat of japan or nickel, failing the possibility of which (as in the case of gear wheels) any steel parts should be kept well greased. Hard woods in general are found to be immune from the attacks of white ants, the latter not touching sound mahogany.—"B.J.," Oct. 15, 1915, p. 677.

[The "mahogany" now obtainable for photographic apparatus is very often a much softer wood than that used years ago. The fact needs to be borne in mind considering the opinion expressed above.—Ed. B.J.A.]

Two-Mirror Reflex Camera.—E. Goold has patented a reflex camera of box pattern, but of reduced size, as a consequence of the use of two mirrors or prisms between the lens and the plate. The first mirror is placed opposite the lens, being mounted on a horizontal axis, which (in a horizontal plane) cuts the lens axis at right angles. It can be turned so as to deflect the rays upwards to the focussing screen, or downwards to the plate, in each case through the agency of the second mirror fixed to the camera body. According to one design shown the focussing screen is placed at the upper part at the back of the camera in a vertical position, the dark-slide and focal-plane shutter being provided in the lower part of the back of the camera. Eng. Pat. No. 1,719, 1914.—"B.J.," Jan. 15, 1915, p. 43.

In another patent specification E. Goold describes a reflex camera in which two mirrors are used between the lens and focussing screen, the object again being reduced bulk of the camera. One mirror is placed close behind the lens and is mounted so as to move from an angle of 45 degrees with the axis of the lens into a position parallel with, and slightly above, the lens axis. In so doing, it allows the rays to fall directly upon the plate placed opposite to the lens. With the mirror down, the reflected rays pass to a second mirror approximately parallel with the first and situated some distance above it. From this second mirror they are reflected to the focussing screen, which is placed very nearly vertical. Eng. Pat. No. 101, 1914—"B.J.," Jan. 22, 1915, p. 58.

Stiffening Sagging Bellows.—Shellac varnish makes a suitable stiffening preparation for bellows which have become soft with age. A quite thick solution is made in methylated spirit and applied

(outside) to the bellows fully stretched out. The bellows are then allowed to get quite dry, the varnish freely mixed with spirit, some lamp-black mixed with it, and the inside surface of the bellows then coated with the mixture.—“Phot.,” Feb. 9, 1915, p. 100.

Timing Shutters by Motor-Car.—A. Wilson points out how a motor-car travelling in front of the camera at a known speed can be used for the determination of the exposure given by an instantaneous shutter. The speed of the car is known from the indication of the speedometer. To the side of the car facing the camera a square of white cardboard is attached, measuring, say, one foot each way. The card is attached to some conspicuous part of the side of the car, where it shows up well against darker parts. The camera is held so that the car travels exactly across the line of sight. It is best to stand back far enough so the image of the car not to occupy more than a fourth of the length of the plate or less, or the photographer may find that he did not press the button at the exact moment when he thought he did, and that, in consequence, the car does not appear on the plate at all.

On developing the negative, it will be found that the image of the square of cardboard is not a square one, but is drawn out in the direction of the travel of the car; and what we have to do, the speed of the car being known, is to ascertain what proportion the length of the image of the card bears to its height, and this will then give us the speed of the shutter.

Suppose, for example, the width of the card in the negative shows an elongation of half as much again—that is, six inches. And suppose the car is moving at twenty-two miles an hour. This latter speed is 337 inches per second. As the card has moved six inches whilst the shutter was open, the time of exposure was $6 \div 337 = 1/64$. The method is not susceptible of very great accuracy owing to the way in which the image of the card shades off at each end, making it difficult to determine exactly the length to be measured. But it does supply a means of checking the really great errors of speed to which many shutters are liable.—“Phot.,” June 15, 1915, p. 445.

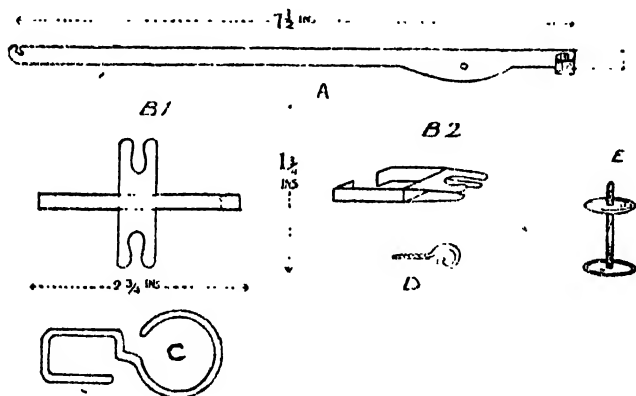
Self Portrait Attachment—A. M. Townend describes how to make an attachment for the ordinary diaphragm shutter by which an exposure can be given after an interval long enough for the photographer to place himself, for example, in a group or the landscape.

The first step was to remove the escapement, and to fit to the spokes of the two smallest wheels small tin blades—to serve as revolving fans to check the speed at which the works run down. To the back of the clock a thin board was attached, on which were placed the winder, the starting lever, pulley wheel, etc., and also a brass pivoted arm which descends and releases the shutter of the camera.

A cord which is attached to this brass arm passes over the pulley wheel and through a tube drilled in the winder. As the clockwork.

runs down the winder revolves, tightening the cord and gradually winding it up and raising the brass arm. Immediately after the latter has released the shutter of the camera it raises the starting lever, and so automatically stops the works, and prevents any further movement and strain on the cord. This starting lever engages a pivoted wire, which acts as a brake on the cogs of the smallest, or escapement, wheel. The action of winding the clock slackens the cord, and allows the brass arm to right itself automatically by means of a spring. --"Phot.," July 20, 1915, p. 45.

H. G. Bartlett describes the construction of a self-portrait attachment, the connection from shutter to operator in the field of the lens being by a length of fine fishing line.



The sketch shows the component parts, namely, a lever A, and a release holder B. These are cut out, as shown in the figure, of thin sheet brass. The shape to cut the lever is easily seen, the dotted portion being turned round. The brass for the release holder is cut like B1 and bent to pattern B2. This holder is for an "Antinous" release; for a pneumatic release make a wire shape like C.

The release holder is fitted just tightly on the top joint of the tripod. It may be necessary to unship temporarily the brass fitting at the top of the tripod joint to get the release holder on. The lever is attached to the top end of middle joint of tripod by means of a screw, or a screw pin like E, so that the short end of lever just touches the release when in the holder. A bulb will be placed so as to lie below the wire ring above-mentioned; for an "Antinous" release the cylinder is inserted between the jaws of the holder, so that the lower part works freely, and is just touched by the small end of the lever. A screw eye D is set in the lower end of the tripod, and about 50 yards of thin fishing line is put on a reel, the end threaded through screw eye and attached by a loose ring to longer end of lever.

To make use of it, arrange your group, compose your picture, and in focusing see that the position you are to occupy yourself is in good focus. When all is ready, set the shutter, and see that the release is in the holder and the short end of lever just pressing up against it. Draw the shutter of dark slide and take the reel of line (the other end of which passed through screw eye and is attached to end of lever) with you to your position in the picture. Keep the thread just taut, and the least pull will make the exposure. It is always possible to manipulate the line with one hand, so that it will not be visible, and in the case of a time exposure it is only necessary at the end of the exposure to let go the line, so that no movement can appear. The line if a thin dull coloured one be chosen, will very rarely show.

It is better to work the line with the hand than to tie it to a peg or rock and work it with foot pressure.

The lever will work well at any distance likely to be needed, without any fear of moving or shaking the camera, as the pull of the cord is downward — 'Aust Phot Review' January 15, 1915, p 31.

Electric Flashlight S. B. Doten has described the production and use of an extremely vivid though small flash by volatilising a small strand of magnesium or copper wire in an electric circuit. The flash has been used for taking instantaneous photographs of small insects at magnifications of 3 to 6 diameters and with quite small apertures of lenses. The best results were found to be obtained by using a 1 inch length of magnesium wire.

The mechanism by which this flame is produced is as follows — A little block of J. M. Transite asbestos wood carries two brass binding posts $\frac{3}{4}$ of an inch in diameter and an inch high, with rounded tops, a strand of No. 31 B and S gauge silver or copper wire is clamped beneath them like a fuse in a branch block. A knife switch whose blade may be thrown into contact at will very suddenly by a pneumatic release and a steel coil spring shoots a heavy current through the fuse. It is instantly vaporised, the vapour springs up from a slot in a block of transite placed over the posts. The vapour shoots beyond the tops of the posts, while from the top of each a jet of vapour pours out which is far more luminous than that from the wire itself — 'Cam Craft,' October, 1914 p 477. 'B J' November 20 1914 p 853.

III.—PHOTOGRAPHING VARIOUS SUBJECTS.

Focussing by Scale with Large Aperture Lenses. T. H. Greenall explains what he calls a 'four stride' system for focussing (by judging distances) in hand camera photography. Briefly the system is to graduate the focussing scale of the camera, not in feet or yards, but in so many strides of the individual user. To a camera of special construction he attaches a series of strips serving to extend the lens to distances which represent sharp focus on objects situated from the camera at distances ranging from four to fourteen strides. The full range of markings was 4, 5, 6, 7, 8, 9, and 14 strides.

Mr. Greenall remarks upon the convenience of such a system as this in providing a means which the user of the camera always has at hand for finding out the distance of the principal object from the camera. He further describes observations made in order to find what latitude was permissible when seeking to obtain sharp focus of objects situated at various distances from the camera. At four and five strides, with a stop of $f/5.6$, he found that there was practically no useful latitude. It was necessary to stand at five strides for an object at that distance. But with the six stride strip he found that an object at six strides' distance remained sufficiently sharp even if he receded two strides further. Evidently there was enough depth of focus with this strip to enable it to be used for objects from six to eight strides' distance, and this was accordingly indicated on the strip. The depth for the seven and eight-stride strips was not exactly determined, but was assumed to be at least up to nine and ten strides respectively, whilst the nine-stride strip was found to be sufficiently correct for objects up to twelve strides. The system was worked out in order to facilitate the use of a large aperture ($f/4.5$) anastigmat of 4 ins. focal length used on a plate measuring $3\frac{1}{4}$ by $2\frac{1}{4}$ —"Phot." August 3, 1915, p. 77.

Enlarged Prints on Wood Cut to Outline. A somewhat more effective form of the jig saw outline portraits described by G. C. Bradbury in the 1914 "Almanac," p. 599, is made as follows. The figure is about 18 inches high and after mounting the print on the

wood the outline is cut out by a professional fret-cutter. One important detail is to mount the head on very thin wood, about the thickness of a 12-sheet card. This is let into the figure so that the coat collar stands out half the thickness of the 3-ply wood used.

This gave a much more plastic effect to the whole figure. The face was carefully finished in water colour, but the clothes were painted in matt surface oil-colour, flat tints being used, the principal shadows and lines being put in with bold strokes of strong colour. This gave a sketchy effect, which suggested a cartoon rather than a photograph. The cost of the cutting out was small, something like ninepence to a shilling per figure. For the base a three-quarter inch piece of deal was used, the surface being covered with glue and dusted with sand, which was in some cases painted over with matt green paint to suggest grass. Boldness and avoidance of small detail are needed to get the proper effect. It is, of course, necessary to paint the edges of the figures in the same colours as the front -- "B.J.," January 8, 1915, p. 17.

Telephotography with Infra Red Rays -- G. Michaud and J. F. Tristan in long distance telephoto work of mountain ranges situated some eight to fifteen miles away have shown the remarkable rendering of detail which can be obtained by using only infra-red rays as obtained by Professor R. W. Wood through a dense cobalt glass filter ("B.J.A.," 1912, p. 583). In order to render the plates more sensitive to the infra-red they employed a special solution of alizarin blue S. This dye gives such great sensitiveness to the infra-red that the exposure for a sunny landscape with a lens working at $f/11$ is cut down to two minutes. But the plates must be used within a few hours of being sensitised as they quickly lose their properties. The following are instructions for sensitising a plate of 7 by 5 inches size.

Alcohol, 50 per cent.	200 c.c.s.
Ammonia	4 c.c.s.
Alizarin blue S.	0.04 gm.
Silver nitrate solution, 10 per cent.	5 drops

All of these chemicals are placed into separate vials. When it is desired to sensitise the plate the ammonia and the alizarin blue are introduced into the alcohol; the flask is stoppered and agitated for about five minutes, to favour the dissolution of the dye. The solution is then filtered into a flask which contains the five drops of the silver nitrate solution. The liquid is moved again and poured over the plate into a 7 by 5 inch dish, which is rocked while the bath acts during exactly three minutes. The plate is then washed for three minutes in running water. After the back has been wiped dry with blotting paper it is laid vertically in a light-proof box, the bottom of which is covered with a layer of blotting paper, and which contains a dish full of fused calcium chloride. About one hour later it may be placed into the plate holder.

From the filtration of the bath until the placing of the plate into the plate holder, every operation must be done in complete darkness or with the help of a very faint green light of the proper kind—i.e.,

made expressly for plates sensitive to the red and beginning of the infra-red.--"Sci Amer," December 26, 1914, p 521. "B.J.," January 22, 1915 p 55

Automatic Correction of Distortion in Copying or Enlarging.—J Becker has patented a special construction of automatic camera, for copying or enlarging whereby to obtain copies or enlargements in correct drawing from negatives which have been obtained with distortion as the result of a non vertical position of the plate at the time of exposure. Full particulars of the optical principles and of the detailed construction of the apparatus are given in Patent No. 5,317, 1915, "B J ." May 28 p 350, and June 4, p 366, 1915.

IV.—NEGATIVE PROCESSES.

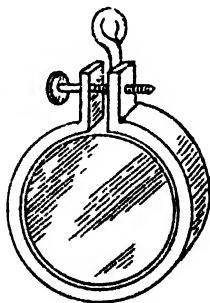
The Gelatino-Bromide Process.

PLATES AND EMULSIONS

Plate Speed After Exposure—Dr C E K. Mees records that measurements showed that, during the first eight or ten hours after exposure, a plate or film shows an increase in speed of about 15 per cent, the speed then remaining constant within the accuracy of measurement. The increase is rapid at first, the speed increasing about 10 per cent in the first four hours. There is little change in the contrast, the change being entirely a shift of the inertia point of the curve. "Phot.," May 11 1915

Orthochromatic Processes.

Temporary Holder for Light Filter—A Lockett suggests the use of a bicycle pump clip, obtainable in different sizes from cyclists' supply stores from 1½d each, as a good temporary holder for a small circular orthochromatic screen, or for a spectacle supplementary lens. A strip of sheet rubber from a printing pad,



or even several thicknesses of paper, may be bent round inside the clip to give a better grip and prevent breakage of the glass. The clip is then attached to the lens hood by tightening the screw nut.—"B J," August 6, 1915, p 514

Deterioration of Panchromatic Plates—"Xtensis" records the result of tests carried out over a considerable period of the extent to which panchromatic plates alter in general speed and in relative colour sensitiveness on keeping

	Speed	Red	Green	Blue
Panchromatic plates at making	Watkins 200	15	15	5
One month later	178	18	15	5
Three months later	140	18	18	5
Six months later	128	24	18	5
Ten months later	117	30	18	5
Twelve months later	120	30	18	5
Twenty two months later	120	36	24	5

The plates work flat as the rule in tests. B I Colour Photo graphy Supplement Sept 3 1915 p 33

Developers and Development.

Time Development with B I Pyro Soda P H Dawson has worked out the temperature coefficient of the B I pyro soda developer (the formula given in the later "Formula Section" of this volume) and from that has drawn up a table of times of development for commercial dry plates based on the classification of these latter according to speed of development of Watkins

The standard adopted for ascertaining and denoting a temperature coefficient is a variation of 10° centigrade (or 18° Fahr). A developer the temperature coefficient of which is 2 will at 40° Fahr require twice the time it takes at 58° Fahr to reduce an exposed plate to the same scale of tones.

The temperature coefficient of the B I pyro developer is 1.5. This is proved by the following example:

At 78° Fahr development is complete in 4½ minutes.

At 60° Fahr (a difference of 18°) development to reach the same density takes 6½ minutes. 6½ is 1.5 times greater than 4½. Herefore its temperature coefficient is 1.5 and the time to develop with this developer at any temperature is always 1.5 times the period required at 18° higher temperature.

As showing the wide difference in temperature coefficients, it may be here remarked that the figure for hydroquinone is 2.25, whilst metol is only influenced to the extent of 1.25. A combination of the two has a "temperature coefficient" of 1.9.

When the temperature coefficient of a developer and also the time required to develop at a certain temperature is known, it is not a difficult matter to plot out a scale of times in minutes and seconds for use with that developer but at this point a disturbing factor is encountered.

All plates that all brands are not alike as to the time required to reach a given density. For instance if we correctly expose an Ilford "Chromatic" plate and a Goerz "Tenax" film, both will require an equal exposure to daylight, but will not be developed in the same time if placed together in one dish. The Ilford "Chromatic" plate will be fully developed in approximately one quarter of the time required by its companion.

To overcome this difficulty of variations in development speed, we cannot do better than adopt the excellent system, devised by Mr. Alfred Watkins, of varying the dilution of the developer to suit the different groupings of plates (also classified by Mr. Watkins), so that only one time table need be plotted out.

On reference to the Watkins Speed Card (price 1d. at any photographic stores), we find the following code, representing groupings of plates in relation to their development speed :—

VVQ, VQ, Q, MQ, M, MS, S, VS,

these symbols signifying different degrees of speed in development from fast to slow. Intending users of the "B.J." pyro time-table are advised to purchase this card.

The "B.J." pyro formula is, of course :

A.—Neutral sulphite solution (see below) ..	14 ozs.
Pyro (sublimed or cryst.) ..	160 grs.
Water to make ..	20 ozs.
B.—Soda carbonate, cryst. ..	4 ozs.
Water to make ..	20 ozs.

The neutral sulphite solution used in making up A is as follows :—

Soda sulphite (cryst.) ..	4 ozs.
Potass. metabisulphite ..	1 oz.
Water to ..	20 ozs.

This latter solution should be boiled if possible, as its keeping quality is improved thereby.

In order to use this formula with the time-table, the following scale of dilutions must be observed :—

SCALE OF DILUTIONS.

When using plates classified in Watkins' Speed Lists as	Take of		
	A	B	Water.
	Part.	Part.	Parts.
VVQ.....	1	1	9½
VQ	1	1	7
Q	1	1	5
MQ	1	1	3½
M	1	1	2
MS	1	1	1
S	1	1	½
VS (develop one third longer than shown by time-table)	1	1	¼

The above dilutions should be taken as a suggestion for a first trial. If the tones of the negative obtained are too steep, employ the next grade (including more water).

In the cases of VVQ, VQ, and Q the following minimum quantities of developing solution for each half plate must be used :—

VVQ. Use not less than 6 ozs. solution for each half-plate.

VQ. Not less than $4\frac{1}{2}$ ozs.

Q. Not less than $3\frac{1}{2}$ ozs.

The reason for this precaution is that in these three cases the developer is so dilute that if lesser quantities than those stated were used there would be an insufficient quantity of developing salt present to complete development.

Degrees, Fahrenheit.	Time to develop given in minutes and seconds.	Degrees, Fahrenheit.	Time to develop given in minutes and seconds.
80	4-9	59	6-59
79	4-14	58	6-48
78	4-19	57	6-58
77	4-25	56	7-8
76	4-31	55	7-18
75	4-37	54	7-28
74	4-43	53	7-38
73	4-49	52	7-48
72	4-56	51	7-58
71	5-3	50	8-8
70	5-10	49	8-19
69	5-17	48	8-30
68	5-24	47	8-41
67	5-32	46	8-53
66	5-40	45	9-5
65	5-48	44	9-18
64	5-56	43	9-31
63	6-4	42	9-45
62	6-12	41	9-59
61	6-21	40	10-14
60	6-30		

It will, of course, be understood that although the time is given to the number of seconds, this is only a guide to be worked as near to as comfortably possible.

Having prepared the developing solution by mixing A and B with the volume of water shown by the dilution scale to be required by the group of plates to which the one employed belongs, the next operation is to take its temperature with a suitable thermometer (obtainable from most photographic stores). Refer to the time-table and ascertain the time to develop. Place conveniently to hand the dark-room clock or a watch showing seconds and the dark slide and developing dish with solution already poured in. Mentally add the "time to develop" to the time shown by the dark-room clock, and at the same time extinguish the dark-room light. Quickly transfer the plate to the developer. The "mental addition," which can be made whilst rocking the dish in the darkness, gives, of course, the time to take out the plate and rinse and fix it. No examination of the progress of development is necessary, and if a light-tight cover is fitted to the dish, the dark-room light may be relit until the moment approaches for rinsing and fixing the negative. If, however, no light is desired during development, a pocket electric flashlamp will suffice to examine the face of the clock or watch, so as to keep in touch with the flight of time.

It is a wise plan to keep a corked bottle of water standing in the dark-room. This, when used to dilute A and B, will ensure the temperature of the solution remaining the same throughout development.

For flashlight exposures a weaker dilution (say two grades weaker) is usually preferable. For example:—A flashlight exposure made on a plate belonging to the group MS should be developed as for MQ, i.e., A, one part; B, one part; water, three and a-quarter parts.

Any kind of negative can be obtained by a higher or lower dilution of developer.—“B.J.” July 9, 1915, p. 445.

Methyl-glycin Developer.—The Berlin Aminlin Works have patented the use of this preparation as a developer, and Valenta, of Vienna, publishes a report on it. It has the formula $C_6H_5.CH_2.N.CH_2.COOH.OH$, and is formed by the action of chloroacetic acid on 4 methylaminophenol. It forms a white crystalline powder, easily soluble in hot water and alcohol. It has the great advantage over ordinary glycine that it will give clear concentrated stock solutions, while the latter, as is well known, only gives thick pastes that clear only when diluted. A suitable formula, which must be diluted with an equal quantity of water before use is the following:—

Methylglycine	50 gms.	350 gr.
Sodium sulphite (anhydrous).....	125 gms.	2 oz.
Potassium carbonate	25 gms.	175 gr.
Water	1,000 c.c.s.	16 fl. oz.

A similar developer was prepared with the ordinary glycine and comparative results proved that the new preparation gave good clean negatives in a much shorter time than the old. As regards rapidity of development Valenta places it midway between glycine and metol. The temperature co-efficient, that is the sensitiveness of the developer to changes of temperature, appears to be about the same as that of glycine—that is 2·3 for 10° C.

The action of bromide appears to be about one-fourth of that with the old preparation. The new salt works well with collodion plates.—“Phot. Korr.” 1915, p. 90. through “Phot. Journ., America,” June, 1915, p. 306.

Two-Solution Amidol Developer.—T. H. Greenall has given full working instructions for the making and use of a two-solution amidol developer suitable for plates and bromide and gaslight-papers. Several stock solutions are required, according to the use of the developer for negative or positive work:—

A. Amidol	16 grs.
Soda sulphite, cryst.	120 grs.
Oxalic acid	40 grs.
Water, to make	6 ozs.

First dissolve the sulphite, then the amidol, and then add the oxalic acid. Some precipitate forms, but must not be filtered off. Shake the bottle when making up the working developer; the

precipitate is of a very light nature, and dissolves completely on mixing the stock solution with that of the accelerator D or E

D Soda carbonate (cryst)	1 oz
Water, to make	16 ozs
E Potass carbonate (B P)	1 oz
Water to make	16 ozs

The working developer is made up by mixing A with D or E in proportions as follows

A, 3 drs, D, 3½ drs water to make 1 oz Or, A, 3 drs, E, 80 to 90 minims water, to make 1 oz

The two solution method enables the worker to adjust his developer to suit his special requirements. For example the hand camera user who prefers a vigorous soft working developer may use 3 drs A 2 to 2½ drs D water to make 1 oz, or 3 drs A, 80 to 90 minims E, water to make 1 oz, or 3 drs A 1½ drs B water to make 1 oz. Any of these will develop a plate classed by Watkins as of medium quick developing speed in five to seven minutes at 65° and give a negative suitable for enlarging. With correct exposure the image appears in about twenty seconds.

On the other hand the stand camera worker may prefer a less vigorous form such as 3 drs A 1 dr B and water to make 1 oz. With this the image should appear in about twenty five seconds, and the development be complete in about eight minutes.

With full accelerator the least light action is affected by this developer at an early stage in the development. The negative goes black all over. One must therefore be taken to avoid all causes likely to produce fog. Phot., October 12, 1915, p. 259

Allowance for Subject in Time Development—L. Sowerby has attempted to devise a system which shall make allowance for the character of the subject (in the matter of contrast) when developing by time.

The subjects are to be classified at the moment of exposure, according to their range of contrast—i.e. the contrast between the highest and lowest tones in which detail is to be preserved. The times of development are to be regulated according to this classification. Thus the more contrasty the subject, the shorter the time of development, and vice versa.

Take the following series of numbers: 3, 1 1½, 1½, 2, 2½, 3, 3½, 4½, 5½, 6½, 8, 10, 12½, 15. These figures represent development times in minutes and are to be compiled into a table by any photographer who will follow instructions.

These particular figures are in geometrical progression, and the common ratio is 5 4ths. That is, each figure is the one before it multiplied by 5 4ths. The series only holds for these developers: Glycin, pyro soda, pyro metol, amidol, ortol, edinol, rodinal, paramidophenol. For metol the common ratio is 7 6ths, the series begins, 1, 7 6ths, 8 6ths etc. For hydroquinone and eikonogen the common ratio is 9 7ths the series will begin 1, 9 7ths, 8 5ths, etc.

An experiment is necessary. Expose a plate on a normal subject,

i.e., one that is neither very flat nor very contrasty, and develop it as carefully as possible, noting the time of development and the temperature. It is important—for obvious reasons—to develop with your usual developer for a time to suit your usual printing process. Now select from your series the number of minutes nearest to your development time. The next figure larger will represent (a) the development time for a similar subject at a temperature 5° F. lower, or (b) the development time for a subject "one degree" flatter at the same temperature. The next figure smaller will represent (a) the development time for a similar subject at a temperature 5° F. higher, or (b) the development time of a subject "one degree" more contrasty at the same temperature.

A table will serve as an example. It is correct for Ilford Versatile plates and the Ilford pyro-soda developer as issued by Messrs Burroughs, Wellcome, and Co. in tabloid form. It should be noticed that standard subjects occupy the middle line; and each figure is greater than the one to its right and than the one above it. The figures are taken in order from the series obtained as above explained. Line C gives the times for the normal subject; B and A are for contrasty and very contrasty subjects (Note.—*Not contrasty results*), and D and E for flat and very flat.

Subject	45	50	55	60	65	70
A ..	6½	5½	4½	3¾	3	2½
B ..	8	6½	5½	4½	3¾	3
C ..	10	8	6½	5½	4½	3¾
D ..	12½	10	8	6½	5½	4½
E ..	15½	12½	10	8	6½	5½

The method may sound complicated, but in reality it is quite simple. It does not take long to learn to classify the subjects and to enter the index letter in the exposure notebook. Apropos of the classification of the subject, it may be helpful to say that the class depends chiefly upon the lighting. Also sea and cloud subjects are usually flat.

In the actual development of the plate there are a few points worth noting. For A and B subjects no bromide should be put into the developer. This will *not* alter the contrast, but will merely help to bring up shadow detail. Fog need not be feared with any good brand of plate. If the developer is diluted, the time varies directly as the dilution. That is, if the developer is diluted to half strength, the time must be doubled, and so on. The developer may be diluted and the method applied to tank development, fixing the plates as the development times are "up." If the plates are to be packed away for development at some future time, it is a good plan to make a note of the subject letter on the corner of the plate. No further information will be required for development.—"A.P.," May 31, 1915, p. 439.

Removing Pyro Stains from Fingers.—W. J. Degge recommends laundry Parazone (liquid bleach), obtainable from oil and colour stores, for removing pyro stain from the fingers and nails. Simply rub the liquid preparation on the fingers with a tuft of cotton

wood. The makers of Parazone are the Parazone Co., Limited, Long Hall Works, Old Ford, London, E.—“B.J.,” April 23, 1915, p. 272.

Fixing.

Deferred Fixing of Plates.—G. W. Bryan recommends as a quite satisfactory procedure when developing plates on tour the use of a mixture of commercial sulphurous acid (not sulphuric) with five times its bulk of water. The developed plates are placed in this solution instead of in a fixing bath. They should remain in it for five minutes or more, and can then be freely examined in daylight. After further rinse for a minute or so longer will do no harm—they can be put to drain and dry, and then packed film to film ready for fixing and washing on return home. Negatives treated in this way have regularly been developed at night and placed overnight to dry, the hours of exposure in the early morning having had no ill effect upon them. “Phot.,” May 25, 1915, p. 378.

Drying Negatives.—Archer Clark calls attention to the usefulness of good washleather for ridding the surface of a negative from superfluous moisture before putting it to dry. The washleather will mop up the maximum of moisture without leaving any particles on the gelatine surface. The leather should be one without stitches in it, and should be washed out in warm water, with a little washing soda dissolved in it before taking into use.—“B.J.,” May 14, 1915, p. 326.

Cleaning Films from Old Negatives.—R. O. Evans gives the following hint on cleaning the films from old gelatine negatives:—In order to avoid the glasses sticking together in a solid mass when placed in washing soda solution, two long pieces of thin string are taken and one end of each is tied round one of the plates, leaving most of the string as a loose end. A second plate is put on the first, and the strings are passed across it, then a third is put on, the strings being pressed back, and so on until the pile is as high as can be soaked. In this way each plate is separated from its neighbours by the thickness of the string. It is best to do the piling in the vessel in which the plates are to be soaked, so that the solution makes its way between each at once, or air may be included and some parts of the film may not get their due soaking. A large basin is filled with a solution of washing soda, a handful of soda to the quart of hot water. Left in this overnight, a scrubbing brush will remove the films in a moment the next morning. The glass should not be left more than a night, as the solution soon attacks it.—“Phot.,” August 10, 1915, p. 100.

Reduction

Softening Contrast by Re-development.—For under-exposed and somewhat over-developed negatives a useful method is to bleach with the usual mixture of bromide and ferricyanide, and after

thorough washing, to re-develop in a bath containing 2 drs. of Anol and 60 grs. of potass. bromide in 12 ozs. of water. This weak and well-restrained developer will re-develop the shadows practically to their former depth, but will not bring up the strength of the high-lights as before. It thus renders a very hard negative quite suitable as regards thinness and softness for bromide enlarging. But it is important to develop thoroughly in the first instance, otherwise the result of the re-development process is an unduly thin negative, which requires intensification. If the process is to be used, the negative should be thoroughly developed. Its hardness will be removed by the after process.

An alternative method, which is useful in dealing with subjects of exceedingly brilliant lighting and great contrast, is to develop even more thoroughly than for the re-development process, using enough bromide to avoid fog and prolonging development until the lights are as black as they can be. Such a negative, after fixing and washing, requires only to be placed in a bleaching bath of iodine to give a perfect printer of soft gradation and full of detail. The iodine bleacher must be used, not chlorine or bromine, as the bleached image does not change by exposure to light, and is denser and more non-actinic than the others.—'B.J.', Oct. 23, 1914, p. 788.

George Chaundy recommends the following process for dealing with hard negatives, the shadows remaining unaltered, high-lights being capable of reduction to any desired extent, whilst there is no loss of detail. The negative is bleached in the usual ferricyanide-bromide bath, washed and exposed to daylight until it has slightly darkened. It is partly re-developed in an old used, or otherwise slow-acting, amidol developer, then rinsed alternately in plenty of clean water (or under the tap) and in a *very weak* bath of clean, fresh hypo (an ounce or so stock hypo in a quart of water), until the reduction is considered sufficient. Development is then completed in the amidol. If, however, the high-lights appear still to be developing too strongly, a second or third application of the weak hypo may be given before the development is quite completed.

If the operations are properly carried out, the resulting negative should be of good colour, without stain, and having ample printable detail in both high-lights and shadows. 'B.J.," November 13, 1914, p. 845.

Copper Bromide for Softening Contrast.—P. H. Palmer recommends the solution of copper bromide, commonly employed as the bleaching agent in the copper intensifier, as a suitable bleacher for "soot-and-whitewash" negatives which are to be reduced in contrast by tentative re-development. The bleacher consists of:—Copper sulphate, 50 grs.; potass bromide, 50 grs.; water, 10 ozs. It can be used repeatedly. The negative is bleached thoroughly in it—until the high-lights are white right through to the glass. It is then washed for a time which "need not be longer than

fifteen minutes," and then re-developed in metol-hydroquinone or similar developer. The negative must be carefully watched at this stage, so as to remove it before the high-lights are fully re-developed, but after the shadows are complete. It is safe to go on until all but the highest lights are blackened over at the back. The plate is then rinsed quickly, fixed for an instant in hypo bath, and then washed. It is best to be content with a moderate degree of reduction, repeating the process if necessary. The process is beneficial as regards removing halation from a negative, since it dissolves away the part of the image next to the glass.—"Phot.," June 8, 1915, p. 429.

Retouching.

Protecting Work on Glass-side of Negative.—As a means of preventing colour dabbled or air-brushed on the glass-side of the negative from rubbing off during handling, celluloid varnish is effective. Before applying the varnish it is best to warm the plate and let it cool again, moist water-colours being usually hygroscopic.—"B.J.," July 23, 1915, p. 483.

Titles on Negatives.—James Dunning gives the following three preparations as suitable for applying to negatives in order to allow of titles, etc., being readily written with pen or pencil. Nos. 1 and 2 take ink better than lead; No. 3 readily takes a soft lead.

1.—Dammar	100 grs.
Benzole	2 ozs.
2.—Sandrac	3½ drs.
Benzole	14 drs.
Acetone	14 drs.
Alcohol	6 drs.
3.—Dammar	½ dr.
Resin	1 dr.
Turpentine	4 drs.
Benzine	4 drs.
Oil of lavender	10 drops.

No. 1 and 2 may be classed as cold varnishes, No. 3 as retouching medium having the resin partly replaced by dammar.—"B.J.," Oct. 30, 1914, p. 814.

Titles on Negatives, in Number.—When it is required to title a quantity of negatives, either in black or white lettering, the whole lot should be set up in type together, and printed on smooth white paper, and copied on a process plate as usual. For white lettering a reversed plate is made from this one, but whichever plate is to be used is soaked with stripping solution and transferred by means of the usual waxed paper to a sheet of glass which has been previously well talced. When the film is fairly set on its new support, strips of gum paper are stuck all round the edge, so as to prevent the gelatine from coming away as it dries. When

thoroughly dry, the film can be cut up as required, and the strips will lie flat and can be stuck on negatives where required.

Where a specially tough result is required, as for border designs or mottoes to be used many times, the talced glass should have its edges smeared with fish glue and a coat of collodion applied. The film is transferred to this, using a little weak gum or fish-glue solution to ensure adherence. When dry, another coat of collodion over the gelatine will complete the job by preventing the curling of the film when cut, and the result will be a very thin and clear but tough strip that will stand far more wear and tear than the plain gelatine.—"B.J.," Feb. 12, 1915, p. 104.

Film Photography.

NEGATIVES ON FLEXIBLE SUPPORTS.

Cellulose Photographic Film.—According to a United States patent of D. E. Reid, assigned to the Eastman Kodak Company, photographic films are made of reverted camphor, with which is incorporated a "filling" of non-oleaginous material, which is practically insoluble in water, soluble in alcohols and other solvents mixable with water, practically colourless, but has no appreciable effect on the photographic emulsion, and does not react with the chemicals used in photography in such a way as to reduce the transparency of the sheet. Triphenyl phosphate may be used as the filling material.—"B.J." (from "Journal of Society of Chemical Industry"), Jan. 29, 1915, p. 71.

Autographic Roll Film.—The patent specification (No. 9,005, 1914) of H. J. Gaisman, assignor of his invention of autographic roll film to the Eastman Kodak Company, is published.—"B.J.," Oct. 30, 1914, p. 811.

The patents of H. J. Gaisman relating to cameras for autographic roll film are Nos. 9,006 and 9,007, of 1914.—"B.J.," Dec. 11, 1914, p. 906.

Scratches on Film Negatives.—The Vanguard Manufacturing Company points out the usefulness of the material "Frictol," sold by them as a local abrasive reducer, for the removal of scratches from celluloid negatives.—"B.J.," Sept. 10, 1915, p. 597.

V. -- PRINTING PROCESSES.

White-Image Developer. - Valenta, as the outcome of examining numerous developing formulæ, has found that the best for the purpose of yielding a white-image with gelatine emulsion dry-plates is the following:—

Hydroquinone	5 gm.	35 gr.
Sodium sulphite (dry).....	20 gm.	140 gr.
Ammonium carbonate.....	60 gm.	420 gr.
Water	1,000 c.c.	16 oz.

A negative developed with this and laid on a black support appears quite white. Adurol (Schering) gives a dark-coloured image, and pyrocatechin and glycin do not give such satisfactory results.—“*Phot. Korr.*” 1915, p. 58, through “*Phot. Journ. America*,” May, 1915, p. 255.

H. Green recommends for the purpose the following:—Soda sulphite, 40 grs.; glycin, 20 grs.; water, 6 ozs. When fully dissolved, add ammonia 2 drs., and potass bromide 10 per cent. solution 2 drs. The image, being almost white, is barely visible during development, but shows as soon as the plate is fixed.—“*Phot.*,” June 22, 1915, p. 476.

W. Ethelbert Henry has published the formula for the white-image developer manufactured and sold for some years past by his firm, the Vanguard Manufacturing Company. On an ordinary gelatino-bromide plate, or dry ferrotype plate, it develops similarly to collodion—both as to image and rapidity of action, the main trouble (to the uninitiated) being to judge when development is complete.

The developer is used at full strength, and can be returned to the bottle for repeated use without discolouration.

The formula, reduced for users on a small scale, is as follows:—

- A.—Dry sodium sulphite 3½ ozs. av.
 Hot water to make 16 ozs. fl.
 While hot, add—
 Quinol (hydroquinone) 120 grains
- B.—Ammonium chloride 3½ ozs. av.
 Ammonium bromide 40 grains
 Hot water to make 16 ozs. fl.
- C.—Strongest liquid ammonia 2 ozs. fl.
 Add B to A, and then add C. Filter when cold.

The following are the instructions for the use of the developer, which, it may be said, is still supplied by the Vanguard Manu-

facturing Co. as "Bertha White Developer":—"The plate must receive a full exposure and must then be developed with this solution without the addition of any water whatever, the plate must then be fixed in an ordinary clean hypo bath. The developer should be returned to the bottle after use, and it will be found to remain in perfectly good condition for a very long time without the slightest discolouration. When first used, the operator will have some difficulty in noting the appearance and development of the image, owing to the fact that the developer causes a white deposition of metallic silver. It can, however, be followed to some extent by viewing the plate occasionally by looking through it towards the light. After one or two trials, there will be little difficulty of this kind—"B.J.," May 28, 1915, p. 359.

Positives Direct with Thiocarbamide.—F. B. Guilbert has given details of the making of enlarged negatives direct from small ones or preparing positives by contact from positive transparencies, according to the method of Perley and Leighton ("B.J.A.," 1913, p. 638) and Frary, Mitchell, and Baker ("B.J.A.," 1914, p. 641).

The process is, briefly, to add the ammonium chloride salt of thiourea to the developer, adjust the temperature carefully and proceed as usual. That is simple.

The salt used is known chemically as tetra-thiourea ammonium chloride. Unfortunately this compound is not on the market, and must be prepared by the worker. Thiourea, alcohol, and ammonium chloride (sal ammoniac) are the only chemicals required for this purpose. The thiourea, or perhaps better known to the trade as "thiocarbamide," can be obtained at any chemical supply house. The method of preparation is as follows: Weigh into a small beaker or other container (non-metallic) which can be heated, 1 gm. or 15 grains of ammonium chloride, and into another beaker 6 gms. or 90 grains of thiourea. To the beaker containing the ammonium chloride add enough 85 per cent. alcohol (made by taking 85 c.c.s. of ordinary 95 per cent. alcohol and diluting it to 95 c.c.s., or proportionally for other units), just a little more than to moisten it. Then heat the mixture to boiling, stirring all the time until no more of the ammonium chloride goes into solution. Then add more of the 85 per cent. alcohol, and continue stirring and boiling, using more of the dilute alcohol a little at a time, as required, until the ammonium chloride has just dissolved, making a nearly saturated solution. Proceed similarly with the thiourea, using the undiluted 95 per cent. alcohol. Now, having obtained the two saturated solutions, bring them both to boiling, and in that state add the ammonium chloride solution to the thiourea solution, stir a minute, and set aside to cool. On cooling, the tetra-thiourea ammonium chloride separates out, forming an apparently solid mass in the beaker. This is removed, spread upon paper, and the alcohol squeezed out, or, if convenient, the alcohol is pressed out between porous tiles. It should then be redissolved in the least quantity of boiling alcohol, allowed to recrystallise, and then given a final wash with cold con-

centrated alcohol. The recrystallisation is not absolutely necessary, but it gives a purer product.

The tetra-thiourea ammonium chloride will keep indefinitely, and a very little of it goes a long way. The following formula is the best developer to use:—

A.—Water	200 c.c.s.	6½ ozs.
Sodium sulphite (dry)	25 gms.	390 grs.
Hydroquinone	4 gms.	65 grs.
B.—Water	200 c.c.s.	6½ ozs.
Sodium carbonate (dry)	50 gms.	830 grs.
C.—Water	1,000 c.c.s.	34 ozs.
Tetra-thiourea ammonium chloride	1 gm.	15.5 grs.

For use mix A one part, B one part, C two parts.

With the exception of temperature, the development is the same as for negatives. The control of the temperature of the developer is absolutely essential to the successful working of the process. The limits are between 15 degrees and 18 degrees Centigrade, or 59 degrees and 64 degrees Fahrenheit, and they *must* be strictly adhered to. A very small change in temperature causes an enormous change in the action of the developer. The negative image appears first, and then the plate apparently fogs, after which the positive can be clearly seen by transmitted light. The time of development is from three to four minutes. The positive image is quite strong, and care must be taken not to over-develop. Its colour is sepia or purplish red, and the negative is black, but very transparent. On a properly developed plate this negative should be so transparent as to be practically invisible by transmitted light. If the negative image is too heavy it indicates over-exposure, while a foggy positive indicates under-exposure. The length of exposure, with one exception cited below, should never be less than normal or more than twice normal.

Plates of moderate speed give the best results. The above-stated formula is for such plates as Cramer Crown, or Banner X. Seed 26 or 27, and Eastman films. For Process plates 2.6 gms. of sodium carbonate extra should be added to each 100 c.c.s. of developer, and for very high speed plates as Lumière Blue Label add four extra gms. of sodium carbonate to each 100 c.c.s.

In making lantern-slides the exposure should be less than that for making a negative, and the developer should be then diluted with an equal volume of water. Line drawings, however, may be reproduced in strong contrast by full exposure and normal developer.—“Amer. Phot.,” March, 1915, p. 124; “B.J.,” March 12, 1915, p. 167.

Sensitometry.

Sensitometry of Photographic Papers.—L. A. Jones, P. G. Nutting, and C. E. K. Mees, in a paper from the Research Laboratory of the Eastman Kodak Company, have dealt with the sensitometric measurement of printing papers, describing the instruments and means for the measurement of densities by reflected light, and

applying the results to determining the specification of a printing paper in sensitometric terms.

Correspondence between the authors and F. F. Renwick appears in "Phot. Journ.," Jan. 1915, p. 29; "Phot. Journ.," Dec., 1914, p. 342; "B.J.," Jan. 1, p. 9; Jan. 8, p. 22; Jan. 15, p. 38, 1915.

Gelatine and Collodion P.O.P.

Ferrocyanide as Desensitiser—N. Sulzberger has applied for a German patent for the use of potassium ferrocyanide as a desensitiser of print-out and development (gaslight) papers. If silver chloride paper is immersed in a 15 per cent. solution of potassium ferrocyanide for one or two minutes it is apparently quite insensitive to light, and an actual fixation with hypo appears to be superfluous. As to the exact chemical action that takes place, it is not clear; apparently the ferrocyanide does not dissolve the silver salts, as subsequent treatment with hypo dissolves out a silver salt. It is possible that ferrocyanide of silver or a complex is formed, for if a faster paper, such as ordinary bromide, be used, then the action of the ferrocyanide does not seem to come into operation. The practical application of this fact would seem to lie in the making of prints very rapidly from negatives, as for press work. For instance, assuming that one has a negative and has printed from the same on any gaslight paper, it would be sufficient to use an acid stop bath, then immerse the print in a 15 per cent. solution of ferrocyanide, wash and dry, so that a print could be ready for drying in four or five minutes.

If a printed-out image, treated with ferrocyanide of potassium, be immersed in a solution of ammonium ferrocyanide solution, the image will absolutely disappear, but it may be re-developed with rodinal without the use of a dark room. This second developed image is black, and is perfectly stable to light. Obviously, an increase of the stability to light is accompanied with an oxidation action produced by the oxygen of the air, as an exactly similar result occurs when the ferrocyanide solution is mixed with an oxidising agent, such as potassium persulphate. Potassium ferrocyanide and ferric chloride also show the same bleaching action, but on re-development in light the whole film turns black, in contradistinction to ammonium ferrocyanide, with which an image is obtained.—"Atelier," 1915, p. 447. from "Phot. Journ. America," August, 1915, p. 405

Bromide and Gaslight Papers.

Two Solution Amidol Developer. T. H. Greenall strongly recommends for the development of bromide papers the two-solution formula already referred to in the earlier section of this Epitome under "Developers and Development." The formula for the A stock solution is given there. For bromide work the accelerator solution (B. or C.) is as follows:—

B. Soda sulphite, cryst.	2 ozs.
Hot water to make	8 ozs.
C. Powdered borax	1 oz.
Hot water to make	16 ozs.

The working developer is made up as follows:—A, 3 drs.; B, $1\frac{1}{2}$ drs.; water to make 1 oz. Or, A, 3 drs.; C, 3 drs.; water to make 1 oz.

In hot weather it is well to add three times the normal quantity of potass. bromide (see below), e.g., A, 3 drs.; C, 4 drs.; potass. bromide, 10 per cent. solution, 15 minims; water to make 1 oz.

In using this two-solution amidol developer for bromide papers, the formula requires to be made up (by addition of 10 per cent. potass. bromide solution) to correspond with the makers' instructions as regards quantity of bromide. Makers' formulae show that bromide papers may be divided into three classes. —

(1) Those which require a mere trace of bromide and give vigour readily, even with a dilute developer containing a minimum of accelerator. (2) Those which require about half a grain of bromide to the ounce of developer, and, for vigorous prints, require a strong developer with a maximum of accelerator. (3) Those which require from one to two grains and upwards of bromide to the ounce of developer. The papers in this class are usually much faster than the others, and have little latitude, but properly used they give charming results from negatives usually considered too strong to make a good enlargement.

Practical tests, with some three different makes of bromide paper, in each of the above classes, enable the following formulæ to be given:—

For a Paper in Class 1. — 3 drs. A, 1 dr. B, $\frac{1}{10}$ grain bromide, water to 1 oz. For these papers the developer may usually be further diluted with advantage.

For a Paper in Class 2. — 3 drs. A, $1\frac{1}{2}$ drs. B, $\frac{1}{2}$ grain and upwards of bromide, water to 1 oz. Dilution of the developer gives greyer and softer results.

For a Paper in Class 3. — 3 drs. A, 1 to $1\frac{1}{2}$ drs. B, 1 to 2 grains and upwards of bromide, water to 1 oz. With correct exposure the image is very slow in appearing. Development is quite unlike that of a paper in Class 1.

The exact amount of accelerator to suit the individual worker will not be far different from that given above. It may be found by dividing the first trial strip into two portions, and developing one portion with slightly more or less Solution B than the other. With a paper in Class 1 or 2, development is correctly carried out when it is completed gradually in from two to three minutes. Increase of accelerator makes it too rapid. In all cases it must be borne in mind that the developer only contains 1 grain of amidol to the ounce, and, consequently, will soon be exhausted.

Further variation in the amount of bromide may be made within certain limits. Increase of bromide allows an increased exposure to be given, and a more vigorous developer (more Solution B) to be used without degrading the high lights, so that we may get deeper blacks; but any increase of bromide must always be accompanied by a fresh trial for the exposure, otherwise its usefulness is lost. Rather than change the developer, it is often preferable to use a harder or a softer working paper to suit a particular negative. All that is necessary for a trial is a small strip of the paper, sufficient

to cover the highest light in the picture, together with a little adjacent shadow.—“Phot.,” October 12, 1915, p. 259.

Water Marks on Matt Prints.—Carbon and semi-matt surface prints on developing paper will occasionally show spots of a different texture from the remainder, due to a little surface water collecting at that point during the drying of the print. While manufacturers have advised that there is no remedy for these, it is found that immersing the prints in a weak solution of alum—1 oz. of alum in 20 to 30 ozs. of water—and bringing the solution to a temperature of about 100 deg. F., will cause them to disappear when the prints are again dried.—“Cam. Craft,” April, 1915, p. 324.

Non-Curling Bromide and Gaslight Prints.—L. C. Bishop finds that the best method of treating gelatine development prints, so that they will keep perfectly flat, is to coat the backs with white of egg. The white of egg is prepared by separating it from the yolk and straining it through a thin cloth. The cloth is wet and the egg white forced through the meshes by hand. Make a temporary bag of the cloth, pour in the egg, and press it through by twisting the ends of the bag with one hand and pressing down with the other. In this way the albuminous fibres are separated, and can be easily spread over the surface of the paper. Using an ordinary rubber-bound paste brush, coat the backs of the prints, much as you would for pasting when mounting solid. Care must be taken to keep the egg from getting upon the face side of the print, for the air would soon cause lumps to dry; so special preparation should be made, and the work done carefully.

Take the prints from the wash water, or soak up any dried ones to be coated, and place them on the mounting slab or table in a stack. Place a sheet of plain wrapping paper between each layer of prints, which are laid so they do not overlap one another. When all are stacked, the surplus water should be pressed out by running the squeegee over the pile. Blot off the backs and coat on the egg in practically the same way you would apply mounting paste. As fast as the prints are coated, lay them out on a stretcher, face down, first glancing at the face to see if any of the egg has accidentally been daubed upon it. If discovered immediately, it can be readily removed by a sponge dipped in clean water.

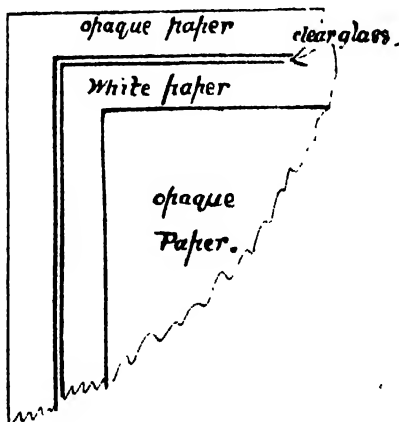
The prints on the stretcher are allowed to surface-dry, and these are placed in blotters, under pressure, and changed several times until dry. Should any become bone dry, do not try to straighten them, but plunge them in water and blot off quickly, when, in a moment or two, they may be put in the blotters.

After treating a few batches of prints this way, one will find it so easy that the extra process will seem to occasion no additional work, and the prints will not curl or warp any more than a piece of plain, heavy paper.—“Phot. Journ. America,” Dec., 1914, p. 529.

Printing Borders on Bromide and Gaslight Prints.—R. H. Hawkins describes a rapid method of printing a border on portrait development prints of the “sketch” type, that is, with a clean white

margin. The rapidity of the method is such that 200 bromides can be exposed per hour, although each requires two exposures. The printer consists simply of a whole-plate frame (for half-plate or post-card prints) in which is mounted the border negative.

The inside measurement of the border having been decided upon, a piece of thin opaque paper, to which has been attached dry-mounting tissue, should be trimmed to fit this measurement. Next procure a piece of thin white paper a little larger than the opaque paper, fix the latter to the white paper, leaving a margin, and mount in the hot press. Now trim round the edges, leaving, say, a quarter of an inch white paper showing. This is best done by using a piece of glass as a straight-edge and cutting with a wheel trimmer. A piece of whole-plate glass is cleaned, and the two adhering papers mounted



in the centre, using a mountant such as "Tixit" rubbed in on the opaque paper to within a trifle of the edges. Do not allow any mountant to get on the white paper margin.

The next step is to paste strips of opaque paper, or, for preference, lantern binders, on the clear glass edges so close to the white paper as to leave the barest possible line of clear glass around the edges of the paper. This is the delicate part of the operation, but is made easier by placing the glass in the retouching desk or exposing box so that the work can be seen. The border printer is now complete, and should be placed in a whole-plate frame (if whole-plate is the size required), pushed up to the top and left side, and fastened securely with gummed strips. A frame is not absolutely necessary, as the device could have "stops" to feed the paper to be fastened on the glass at the top and left side, but a printing frame is convenient, and protects the device from injury. To facilitate working, the small wooden blocks of the frame at the lower corners should be knocked off, so that the "feeding" can be done by sliding the paper

in at this end. The hinged back of the frame should have a piece of wood nailed along the length way so as to make it a solid piece and at the same time serve as a handle. This is used to press the bromide paper up to the negative. In all the operations described here it is assumed that the worker uses some form of printing box with a light in it, such as the one described in the "B.J." of March 26, 1915, p. 196.

A print should be made from this device on P.O.P. or bromide paper (card thickness for preference), taking care to "feed" the paper up to the top and left sides of the frame. When dry, the print should have the centre part (up to the inside of the grey border) cut out. The outside portion is the permanent guide, and a mark should be put on the back of it to indicate which end was fed up to the top. For very accurate work it is best to make the guide border print on P.O.P. card untuned and unfixed, as there is often a slight stretching of papers after the usual fixing and washing.

The portrait negative having been adjusted over the vignette in the exposing box is fastened securely, the border guide placed film down on the negative, adjusted so that the portrait is correctly placed in the opening, and some sort of registration marks are made at the top and left sides. Strips of white gummed paper can be used, but the method will vary according to the size or shape of the particular printing box used. When a large number is to be done from one negative, get a large piece of white paper, cut out an opening larger than the vignette, fasten it to the glass of the exposing box, and make the registration marks with a pencil, using the border guide as the straight edge.

In making the first proof print, the paper should be fed up to the marks, pressed down with a piece of card (to which has been fixed a handle), and the exposure made. Next place the exposed print in the frame of the border device, pushing it well up to the top and left sides, and make another exposure, considerably shorter than that given for the portrait. Unless two exposing-boxes are available it will be necessary in making the first proof to expose the border part to some other light. The exposure need not be accurate, as the proof is only intended to make sure that the registration marks are correct, and when all the portrait exposures are made and carefully placed the same way up in a pile, the border frame will then take the place of the portrait negative. The exact exposure for the border will depend upon the result required, but generally it should be so adjusted as to print grey, with, of course, a neat black line given by the clear glass.

The operations take longer to describe than to do, and many workers will make modifications to suit their own methods. A large number of photographers do vignette heads on postcards, and print them in strips in the usual strip frames, and excellent results can be quickly obtained by making one of the devices described so that the outside of the border is about an eighth of an inch smaller than $5\frac{1}{2} \times 3\frac{1}{2}$. This device, mounted on a half-plate or postcard size glass, can be quickly placed in the strip frame and the exposures made. Higher prices could be charged for these.

A very tasteful effect is produced by toning the portrait part only

in the sulphide bath, leaving the border black or grey. This is easily done by using a stronger bleacher than usual, applying it to the portrait with cotton wool, blotting off the bleacher, and placing the print under the tap, allowing the water to run full on the portrait. The whole print is then put in the sulphide bath.

The photographer's name can be written (in reverse) on the white paper margin of the device, so as to show on all the prints.

The device can also be used in the enlarging camera for printing an effective border; if used for this purpose it is advisable to make the white paper more translucent by painting it over with paraffin. — "B.J.," Aug. 20, 1915, p. 543

Two Solution Amidol Developer.—T. H. Greenall recommends a two solution amidol developer made up as directed above under "Bromide Papers." The following formula for the working developer gives clean and delicate prints and an excellent pure black; 3 drs. A, 1 dr. B, 110 grain bromide, water to make 1 oz. An acid fixing bath must be used, and to ensure a pure black it must be fresh for each batch, and not one which has been previously used for bromide papers. The exposure must be as nearly correct as possible. The C solution (borax) should not be used for gas light papers. — "Phot.," October 12, 1915, p. 259.

Toning Bromide and Gaslight Prints

SULPHIDE TONING

The Permanganate Bleach Process.—David Ireland writes in warm commendation of the permanganate bleach process of T. H. Greenhall ("B.J.A.," 1914, p. 655), which he considers certain ultimately to displace the ferricyanide-bromide bleacher. The chief advantage of the permanganate method is the fine quality of the high-lights, due, it is suggested, to the bleaching of paper, gelatine, and any developer stain by chlorine liberated from the bleaching solution.

It is found that the print which has been sulphide-toned by the permanganate method yields quite readily to a second application of the permanganate acid bleaching bath. On again sulphiding, the resulting tone is considerably colder than after the first toning. A convenient formula for the bleaching bath is: Water, 10 ozs.; hydrochloric acid, 1 dr., then add 1 dr. potass. permanganate solution of strength 12 grs per oz. of water. — "A.P.," Jan. 11, 1915, p. 26

Non-Effectiveness of Chrome Alum Bath.—The use of chrome alum as a hardening bath, or in the fixing bath, having been stated to improve the colour of the result obtained on sulphide toning, the tests made by a member of the staff of the "B.J." are of interest. It was tried under various conditions. Some prints were alumed, washed, and dried before toning. Others were dried and then alumed immediately before toning. Others, again, were alumed and toned before drying, while various strengths

of alum, both with and without acid, were tested without the slightest result. It would appear that chrome alum has no effect upon the tone produced in the sulphide bath.—“B.J.,” Dec. 11, 1914, p. 898.

Sulphide Toning from Hard Negatives.—Sometimes bromides are wanted from a very hard negative, and it becomes necessary to over-expose the prints in order to obtain any degree of softness. In ordinary circumstances such prints will turn out very “gingery” after toning, but if put into the sulphide solution first for one minute and rinsed before bleaching they will be found not to bleach so completely as usual, and will finally tone to a satisfactory colour. This method also works well with most kinds of gaslight papers, but in the case of this class of paper the preliminary immersion in the sulphide should be a good deal longer—say, five to ten minutes. The longer the time the colder the tone.—“B.J.,” Oct. 30, 1914, p. 809.

Blue Stains in Sulphide Toning.—Messrs. Rajar, Limited, recommend the following bleacher for use when there is a liability of blue stains being formed on the prints as the result of iron in the water supply:—

Potass bromide	6 ozs.
Potass bichromate	6 ozs.
Water	1 gallon
Hydrochloric acid, commercial	8 ozs.

This bleacher gives the same tones as the usual ferricyanide-bromide bleacher. The prints require rather more washing between bleaching and sulphiding than when ferricyanide is used.

When it is not possible to obtain organic developers, and the iron developer is used, the above bleacher can be used with perfect results.

Photographers occasionally find a difficulty in bleaching prints with the ferricyanide-bromide bleaching solution, some parts of the prints refusing to bleach properly. This defect can be cured, or prevented from making its appearance, by adding fifteen drops of ammonia .880 to each pint of bleaching solution.—“B.J.,” April 23, 1915, p. 278.

A correspondent of the “B.J.” adds his experience to the above to the effect that trouble in the form of blue stains was found to be prevented by taking the precaution of giving free access of hypo to every part of the print when it is first placed in the fixing bath. If the prints stick together or bubbles adhere to the faces of prints, when first placed in the hypo, some compound appears to form which no further fixing can remove, and which gives rise to the blue stains.—“B.J.,” May 21, 1915, p. 342.

G. T. Harris, writing in reference to the suggestion that blue stains on sulphide-toned bromide prints are due to iron deposit in the water (when a ferricyanide bleaching bath is used), states that in practice it is certainly found that iron-impregnated waters do not

invariably give rise to this effect. He uses water which, after standing for a day or two, deposits a flocculent iron compound. Prints were washed with water containing this deposit, after bleaching in the ferricyanide bath, but without any production of blue spots. — "B J," April 23, 1915, p. 278

Sulphur Toning in Acid Solution G. S. Hoell finds that bromide and gaslight prints may be toned with success in a mixture consisting of a solution of hypo, with addition of hydrochloric acid. The toning action of this mixture is evidently on same lines as the processes of cold sepia toning described by A. and L. Lammère and A. Seyewetz, J. Desalme and H. Noat ("B J", 1914, p. 660). The action takes place in from ten to fifteen minutes, but the tone does not become apparent until after washing in running water for a couple of hours. The following are the instructions for the use of the process, the hypo being obtained in suspension in gelatine by first soaking the prints in a solution of hypo and then transferring them to a bath of hydrochloric acid.

Soak the finished and dry print for ten minutes (if hardened in acid hypo, say, fifteen minutes) in a fresh solution of hypo of a proportion of about 1 oz. of hypo to 4 ozs. of water. If the solution is colder than 65 deg. F., soak somewhat longer. Prolonged immersion will reduce the print perceptibly, and if two prints cling together for any length of time, uneven toning will result. After soaking drain off all superfluous hypo, and pour into the tray a mixture of 4 drams of pure concentrated hydrochloric acid and 10 ozs. of water. This solution should be preferably at about 70 deg. F. Rock the tray for five minutes and ensure even covering of each print by the acid solution. After this treatment no visible change has taken place: pour out the acid solution, which now has a milky appearance and wash the print for an hour in running water which will free the paper of any acid that has soaked in, and the print can now either remain in the running water or be transferred to a tray of clean water, where it should remain until the complete change of colour has taken place. In winter, in a cold room, with water at 40 to 50 deg. the change will take place after ten to fifteen hours, whereas in warm weather it may take only one hour. If the immersion in the hypo bath has been too short, the deep shadow portions will not have absorbed as much as the lighter shades, particularly if the print has been hardened while being fixed, and the middle tones will turn light brown, while the shadows remain black. If, after a short washing, the print is taken up and dried, it will remain black and white and although experiments have not been carried on to prove it, it is possible that the toning will take place due to the moisture in the air, after several months or more. A print that shows signs of reducing has been in the hypo bath too long, or the bath has been too strong or too warm. The weak hydrochloric acid bath seems to have no bad effect, except that prolonged immersion or too warm a bath will cause frilling at the edges when the print has not been hardened. The final tone is not dependent upon the accurate strength of the hypo or acid bath if the change of tone is complete, but, like

ordinary sulphide toning, is dependent upon the emulsion, the original developer used, and the extent to which development has been carried out, full, strong development giving the best results. A flat negative that gives but little contrast in the print or enlargement is no more desirable for this process than for ordinary sulphide toning, but the results are better by the acid method—i.e., the resulting colour is more pleasing to the eye—"Photo-Era," March, 1915, p. 127.

Sepia Tones with Schlippe's Salt.—A formula found effective by an American worker is as follows:—

Potassium ferricyanide	180 grs.
Potassium bromide	60 grs.
Water	20 ozs.

The bleaching is fairly rapid, is followed by a short washing in running water, after which the print is immersed in

Schlippe's salt	1 oz.
Water	20 ozs.

This last causes the print to turn to a yellowish red when it is placed directly into a 5 per cent. solution of ammonia to soak for a few moments. Again washing in running water, it is placed in the final toning bath, made up as follows:—

Copper chloride, 10 per cent. solution . . .	1 oz.
Hydrochloric acid, 10 per cent. solution . .	1 oz.
Water	20 ozs.

A half-hour immersion results in a handsome sepia or rich brown tone, when a final washing and drying are given.

The advantages of this process over the ordinary sulphide process lies in the almost entire absence of disagreeable odour and the necessity of having the original print of a quite vigorous nature. In addition, there is a lack of yellowishness, such as results when attempting to tone a soft, delicate print sepia with the sulphide process. If a print having a brick red tone is desired, one may substitute a platinum bath for the copper one given above. This may be made by dissolving a 15 grain tube of potassium chloroplatinite in 1 oz. of water, with the addition of a little hydrochloric acid. Put 1 drachm of this solution in 10 ozs. of water, and add 1 drachm of a 10 per cent. solution of hydrochloric acid. Placed in this toning bath, the print soon gains the desired red colour, when it must be washed in running water for a few minutes, and then treated to a weak hypo bath. If immersed in the platinum-bath for the completion of the toning process, the print will finally assume a rich brown tone, and will then need no hypo-bath, merely the few minutes' rinsing or washing.

The original print must be thoroughly fixed in a hypo-bath of sufficient strength to remove all the silver, and the washing following this fixing must be thorough enough to remove all the hypo. The only other precaution that needs attention is that the Schlippe's salt bath should be followed immediately by the diluted ammonia. Failure in this last will be quite sure to result in degraded whites—"Cam. Craft," Oct., 1914, p. 507. "B.J.," Dec. 4, 1914, p. 888.

The Carbon Process.

Spirit Sensitizer for Tropics.—Tan Hock Ann, writing of experience in carbon printing in the Malay Peninsula, gives formula for the sensitising solution which has been found very satisfactory. It is

Ammonium bichromate	180 grs.
Soda carbonate	30 grs.
Water	12 to 13 ozs.

Take 1 oz. of this and add 2 ozs. of spirit.

Use this solution at 80 deg. F., immersing the tissues between 20 to 30 seconds (at first face downward, then upward, then downward again), and squeezing them on a glass to remove excess of the solution before putting them to dry in a box.—“B.J.,” November 13, 1914, p. 845.

White Carbon Tissue. A new material for the carbon process has been placed on the market as “Autotype White Carbon Tissue.” A demonstration of the new material by A. C. Brahm before the Croydon Camera Club showed the extremely novel effects obtainable by its use. The tissue requires to be printed from a positive and to be transferred to a transfer paper of dark colour, either black or of some other fairly intense colour which, it will be understood, forms the shadows of the print, the white carbon image constituting really a species of stencil which shields to a greater or lesser extent the dark paper beneath it. One transfer paper (black) is commercially issued; others may be prepared from ordinary carbon tissue by treating it with bichromate solution and exposing it very fully to light. By the use of green, brown, blue or grey tissue for the reception of the white image, some very pleasing results are obtained. A further useful feature of the process is the fact that it provides the means of producing a white image upon wood, metal, or other surfaces, the parts of the material not bearing the image being left completely uncovered. The use of the white tissue thus allows of attractive labels, etc., in white lettering on the natural surface of some chosen material being readily made.—“B.J.,” Oct. 8, 1915, p. 661.

Platinum Printing.

Silver-Platinum (Sotista) Paper. W. Willis has patented the preparation of a paper containing salts of iron (sensitive to light), silver, and platinum. The image consists of silver and platinum, the proportion of the latter varying according to the amount of platinum salt used in the sensitive coating.

Enough platinum may be formed in the image to render the image quite permanent—that is to say, enough platinum is used to give an image still recording the gradation and detail of the subject after the full image has faded or been artificially removed.

The basis of the process is the way in which the chemical reduction of silver chloride by solution of ferrous oxalate in potassium oxalate is facilitated by the presence of a small quantity of chloro-

platinite of potassium in contact with the silver salt before the reducing agent (ferrous oxalate) is applied

The only platinum salts found of value for this purpose are chloroplatinites and chloroplatinates. In the use of these compounds, according to the above process the platinum is likewise reduced to the metallic state at the same time as the silver by the ferrous salt forming the image on the paper.

In the preparation of the paper one method is as follows. The paper is given a coating of silver chloride either as a gelatine emulsion or by forming the chloride by double decomposition. The coated surface is then coated with solution of ferric oxalate containing also potassium chloroplatinite.

After exposure to light the faint image, consisting mainly of ferrous oxalate, is rendered soluble by solution of potassium nitrate and immediately reduces the silver and platinum salts with which it is in contact.

Typical formula for the preparation of the paper are as follows. Plain paper is used for the platinotype process, is first salted in 5 per cent solution of potassium chloride and silver chloride formed in it by means of a 5 per cent silver nitrate solution. The surface of the paper is then washed. As already mentioned, an emulsion of silver chloride may be used in place of this salting process.

The coating solution applied to the silvered paper consists of potassium chloroplatinite dissolved in solution of ferric oxalate of the kind usually employed in preparing platinotype paper. From 1 to 6 gms of potassium chloroplatinite is dissolved in 500 ccs of the ferric oxalate solution. For an image mainly of silver the smaller quantity may be used, for an image containing a permanent residual image of platinum about 6 gms are used.

The "developer" for the exposed paper consists of potassium oxalate 1 lb water 64 ozs. The print develops in about one minute, and is then cleared in

Potass bisulphate	3 ozs
Potass oxalate	$\frac{1}{2}$ oz
Water	100 ozs

in which it remains for from 10 to 15 minutes. It is then well washed, "fixed" in hypos solution 1 to 10 and again washed.

The process is above described can be well applied to paper surface hardened or parchmentised with sulphuric acid. Also, the platinum salt may be placed in the "developer" instead of in the coating on the paper. Eng. Pat. No. 20 022 1913 "B.J.," October 16 1914 p. 777.

Satista Paper. In a demonstration before the Croydon Camera Club, Mr. W. H. Smith Works Manager of the Platinotype Company, dealt with the manipulation of the commercial "Satista" papers. Emphasising the remarkable platinotype effect of the "Satista" prints, he dealt with the question of permanency, saying that a "Satista" print might be considered as permanent as a bromide, and, in addition, to have a certain reserve of permanency. For if all the silver should disappear in the course of years, all

the original detail would still remain as a platinum image of softened gradation. This point was illustrated by removing the silver part of the image with acid permanganate; after clearing the permanganate stain there remained a charming and delicate print of the subject. It was suggested that a reduced "Satista" print might meet certain requirements of the colourist in a way afforded by no other photograph.

Of the two grades of "Satista," black and sepia, both were coated on semi-matt hard-surfaced paper similar to Japine. The two papers should not be stored together, or developed in the same bath; otherwise, they need not be kept apart. At low temperatures of development the sepia papers gave a good black, though not such a clean print as the black "Satista." The colour obtained on the sepia paper is not so warm as sepia platinotype or sulphide-toned bromide, and the degree of colour varies with the temperature of development, beginning at about 100° F. with a brown tone, and reaching a maximum about 160° F.

The "Satista" papers, said Mr. Smith, keep well for two or three months in waxed paper wrappings, or for longer in calcium tubes. After printing they might be kept for a day or two in a box or drawer without special precautions, even in damp weather. Exposure to daylight was about one-third the time of platinotype, that is, about one-sixth the time of P.O.P. As regards the semi-visible image, the tendency with "Satista" was to over-print if the paper was judged as in platinotype printing; high-light detail was not so visible. But unlike platinotype, over-printing did not produce granularity and loss of quality. With twice the proper exposure the paper might be developed by adding an equal bulk of pure glycerine to the developer and taking the prints out at the right depth. There was very little difference in the gradation or colour of the print. After development, which was complete in thirty seconds, and could not be overdone, prints are passed through two clearing baths consisting of potass. binoxalate. Again they are washed for a short time, fixed in 1:10 hypo, and finally well washed.

Mr. Smith pointed out that for a warmer colour than the "Satista" sepia, prints might be toned with uranium or with sulphide. Very fine shades were obtained on the sepia paper by toning with gold and formate of soda.—"B.J.," Oct. 30, 1914, p. 808.

Miscellaneous Printing Processes.

Photographs on Watch Dials.—J. Gurich and A. Ochotorena have patented the following method of preparing photographs on watch dials: A negative is taken of the subject in the usual way, and a positive transparency on glass made from it. The part of the film containing the subject is cut all round so that it is separated from the remainder whilst *in situ* on the plate, and the whole plate is then immersed in a strengthening and hardening solution. Such solution may be:—

Water	100 parts.
Formaldehyde (40 per cent.)	8 parts.
Carbonate of soda crystals	7 parts.
Glycerine	1 part.

After, say, ten to fifteen minutes, the plate is taken out and immersed in the second solution which effects the loosening of the film. This may be:-

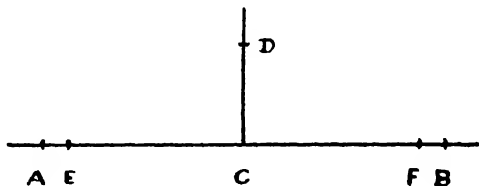
Water	100 parts.
Hydrochloric acid (conc.)	5 parts.

When about one minute has elapsed and the plate withdrawn, the portion of the film required may be freely peeled off, and may be immersed in an agglutinant bath, say, of gum arabic, and the photograph then applied to the dial.

It will be found that the film will curl and contract round the edges of the surface under treatment and draw tight that portion bearing the image on the front of the dial. The picture may be tinted afterwards in the usual manner.—Eng. Pat. No. 27,442, 1913 "B.J." February 19, 1915, p. 120.

Trimming, Mounting, and Framing Prints.

Drawing an Oval to Size.—B. J. Rose has described the following neat way of drawing an oval to any required dimensions:- In the diagram, let A B be the required length of the ellipse. Exactly midway draw a line at right angle as shown, and at D make a prick distant from C half the required width of the ellipse. Set a pair of compass-dividers to the distance of A C; and, inserting one point at D, trace the other point until it meets the line A B at the



two points E and F (the foci), marking these points. Insert pins firmly at the points D E F, and tie a piece of thread round them, permitting no slackness. Remove the pin at D, and substitute a finely pointed pencil (a retouching pencil answers capitally) which is worked round, bearing against the thread in the usual way, and the ellipse is described of the required length and width.—"B.J." September 24, 1915, p. 628.

A Revolving Print Trimming Table.—A. Weber gives working sketches of a rotating table for print trimming which can be readily made at home. Fig. 1 is a plan of the base supporting the rotating turntable. B is the bolt for the pivot carrying the rotating circular top. C.C.C.C. are castors consisting of small rollers mounted on

metal brackets, as more clearly shown in fig. 2. At a pinch, cotton reels could be made do for rollers. E.E.E. are screws passed through the bottom of the board to act as legs (see also fig. 2).

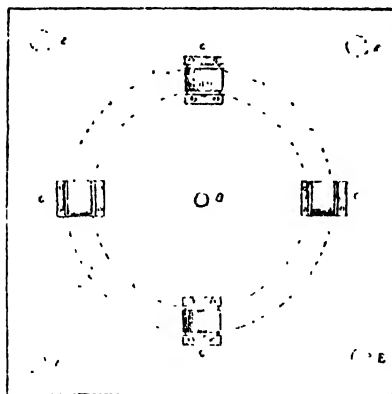


Fig. 1.

Fig. 2 is a side elevation of the table. A is the top, and is of about $\frac{1}{2}$ -in. board, 10 ins. square, and covered with soft cloth. B is a $\frac{1}{4}$ -in. bolt serving as the pivot and with the top counter-sunk

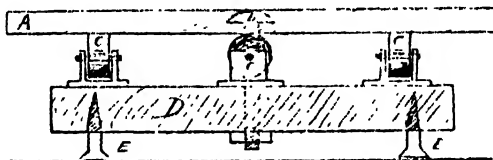


Fig. 2.

C.C.C.C. are the rollers of the castors. D is the baseboard of about $\frac{3}{4}$ or 1 in. thickness, and E.E. are the screws serving as legs to keep the nut of the bolt off the table—"Aust. Phot. Review," Jan 15, 1915, p. 43.

Indented Line Round White-Margin Prints. A neat method of making a narrow depressed line round a print with a white margin or mounted in the ordinary way was shown by Mr. B. J. Rose at the Croydon Camera Club. Suppose the line is required to surround, say, a picture 6 x 4 ins. at a distance of 1 in. from it. Two pieces of paper are cut about 9 and 7 ins. long, each exactly 1 in. in width. The longer piece is laid against the length of the picture almost in contact with its edge, the shorter piece being similarly laid against

the top of the print. We have now, so to speak, half a paper "Oxford" frame in position, and if a pin prick be made at the outer intersection the position of one joint is correctly indicated, the others being obtained in the same way — "B J," July 16 1915, p 468

Flattening Prints on Thick Paper — Postcards or prints, generally of the sketchy type, on double weight paper are best flattened by putting through the hot dry mounting press but the secret of making them remain flat is to first press face up (assuming the press is heated from above) then to remove from the press and at once lay face down on the still hot zinc plate. The print instantly begins to curl the reverse way, i.e., the face becomes the convex side. If removed as soon as this tendency becomes evident it will remain indefinitely in this flat condition. With a good size press, several prints can be done at once and it takes less time than the ordinary dry mounting. "B J," July 30, 1915 p 197

Mounting Without Curling — When mounting prints by the corners only on paper or thin card a means of avoiding cockling of the mount is the following recommended by H. Allen. The print is first laid upon the mount in the exact position which it is to occupy and a pencil dot is placed to indicate its four corners. With a sharp knife and a straight edge as a guide two clean cuts are made diagonally across the area so marked out on the mount, approaching the pencil dots to within about a quarter of an inch or more according to the size of the print. The print is then mounted by its corners being left under gentle pressure until thoroughly dry. The cuts allow a little play for the mount and let it adapt itself to the tension put on it by the print. They may be hidden by means of a second mount when adopting a multiple mounting system — "Phot" July 27 1915 p 71

Hot Dry Mounting with Glue — H. Deller recommends a method of mounting prints without tendency to curl, with loss of hardly any gloss and using the prints quite dry. The prints to be mounted are trimmed and allowed to get quite dry. A little ordinary hot glue (not too strong) is brushed on to the top of a hot iron plate which may be supported on an upturned brick at each end. Underneath the iron plate is a small spirit lamp which keeps the plate just about as hot as the hand can bear. Then a little of the glue is brushed on to the hot iron plate and spread evenly over it in the form of a white frothy coating. A print is picked up and laid down on the glued surface rubbed into contact picked up and placed at once in position on the mount and passed once or twice through an ordinary wanner with a good pressure. "Phot" June 15, 1915, p 457

Multiple Mounts by Dry Mounting — G. B. ' gives the following instructions for the home production of multiple mounts by dry mounting the commercial border tints —

These can be had in sheets 24 in. by 20 in., or in the usual cut

sizes at the same prices as the tissue. They are supplied in smooth or linen surfaces, and provide the means of making an almost unlimited variety of mounts in styles to suit all classes of prints. Of course, other papers can be used as tints if desired, and for these one merely has to attach a sheet of tissue just as for a print. Most of the ordinary greys are too blue in character to show bromides to the best advantage and are apt to make them look rusty by contrast. Although any kind of board can be used as a base when making multiple mounts, it is not easy to get and inconvenient to stock such a variety as one could wish for and a pulp board of four sheet thicknesses faced on one side with white paper is an excellent material. It can be bought very cheaply in imperial size, 32 in. by 22 in. and pieces covered on the pulp side with a sheet of "tint" are easily cut clean with a knife and straight edge or in

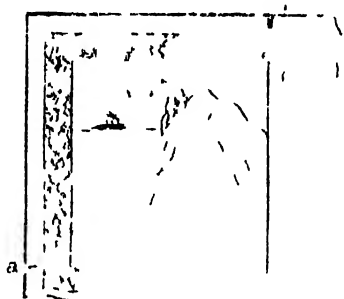


Fig. 1

a guillotin trimmer. The large 24 in. Merritt trimming desk will also cut these boards quite easily, and yet they are quite stiff enough for all ordinary purposes, and will remain flatter than the usual 'art mounts.

To cut a border tint a piece of suitable size is taken and one corner trimmed to an accurate right angle (it is no good relying on the accuracy of the cut pieces as they come from the makers). The trimmed print is then laid on it at a distance from the two cut sides just double the margin required. That is, if a quarter of an inch all round the print is wanted the print is laid half an inch from the two cut edges of the sheet of tint. This is lightly marked with pencil against the other two sides of the print, as shown at A in fig. 1, and the piece is then trimmed to those marks. It is desirable to try the print on the cut tint before proceeding further, and if found correct a mark is made on the tint near to the right hand top corner. It will be found that with narrow borders the print will fit only one way up, and in all cases the same trimmer must be used for both print and tint. Another plan which is really a better one when cutting rather narrow borders is to arrange the print on the sheet of tint as before, seeing that the

corresponding edges are quite parallel, and trim the other two sides of print and tint in one operation. Extreme care must be taken not to allow them to slip in the slightest degree, but if skilfully done there is not so much margin for error as in the other way. After a little practice several tints can be done at once to form a most effective mount with borders of various widths and colours around the print.

When cutting thin lines the precautions of keeping everything dry should be strictly attended to, and when cut they should not be allowed to lie about and absorb dampness from the air, but should be pressed on the mount without delay. In this way extremely fine lines can be arranged if desired. Where very slight corrections in trimming are needed it is best to do them with a sharp knife and a good steel straight-edge rather than try and cut small shavings in a trimming desk.

As one generally mounts several prints at a time a little system becomes advisable in trimming, marking and pressing the borders and prints. Each print and tint must be pressed separately unless a very soft thick base be used. The reason for this is shown by a

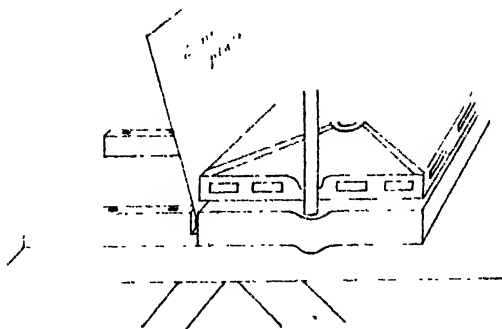


Fig. 2.

diagram representing a multiple mount in the press in section. Fig. 2 is self explanatory. The first print is marked on the back with soft pencil 1, as also the border tint on the front near the right-hand top corner (where it will not show after mounting), and if several tints are to be used on a mount each one is similarly marked, with the addition of A, B, etc., commencing with the outside one. The second print with its tints is marked 2, as before, and by always marking in the proper corner there will never be any doubt as to which is the top, or whether a mount is for an upright or landscape print. The prints are laid in one pile, the borders in another, and the cards in a third as they are cut, so as to keep them in order and prevent any muddle. When all are cut each card has its first tint fixed and then the set is pressed, the next tints are fixed, pressed, and, finally, the prints. In addition to the saving of time and gas that this system effects, the need of a higher temperature for tints is more conveniently arranged for than if each print is separately mounted—"B.J.," March 5, 1915, p. 154

In Place of Sliding Bed on Dry-Mounter.—Many mounting presses are not fitted with a sliding-bed, and with these it is necessary to lift the zinc plate with the print, mount, and underlying sheet of cardboard before they can be slid into the machine. The simple device illustrated does away with a lot of this fiddling about, and at the same time saves the fingers a good deal of handling of the hotplate.

It consists merely of two strips of wood planed to be exactly level with the bed-plate of the press and screwed to the bench in front of the machine so that the prints can be slid in and out without any lifting up and down. At the end of the strips of wood next to the mounter a corner is cut out of each, thus forming a slot, into which



the hotplate slips on raising it with a forefinger of each hand, and in which it will stay without slipping about $\frac{1}{2}$ in. wide by $1\frac{1}{4}$ in. deep.—*B.J.*, Nov. 27, 1914, p. 872

Pass-Partout Framing—In a demonstration at the Croydon Camera Club Mr. B. J. Rose showed a simple way of fixing passe-partout binding strips to the glass so as to ensure an equal width of binder all the way round the front of the "frame." A length of binding strip is taken, slightly longer than required, placed face down on a piece of clean paper, and an adhesive applied. A compass divider is then set to the width of the front edging determined upon, the strip removed and placed on a baize-covered drawing-board, and, setting off from the edge of the strip, two prickings are made some distance apart, pins being inserted in the minute holes thus made. The glass is now bedded against the pins, which ensures the binding strip being attached perfectly parallel with the edge of the glass. The other side is then treated in the same way, the protruding ends are cut off, and the top and bottom attended to. It is easy to "mitre" the corners, but many think, especially with narrow borders, a plain lap-over looks as neat, if not neater. The picture and back are now placed in position, fresh adhesive is applied to the free edges of the binding strips, which are brought over and stuck down.—*B.J.*, July 16, 1915, p. 468.

"H. H. M." gives the following hints on securing permanence of the paper binding in passe-partout framing:—The glass should be thoroughly cleaned—from grease of any kind—with weak ammonia or Monkey Brand soap. The main objection to this

style of framing is that the binding is very liable to leave the glass in time, but this can easily be overcome with care. First of all, see to it that the glass is clean and free from grease of any kind. This can be secured by using Monkey Soap or dilute ammonia. Then with starch paste stick on the edges of glass a strip of very thin paper (some kinds of tissue paper will answer very well) just a little narrower than the final width of binding, and allow to get quite dry. The final binding strips are placed in position, and there is no fear of them leaving the glass. Most people put on the final strips too dry. Always slightly moisten the front of strips to make them more pliable. The best method is to paste the gummed strips, as a mixture of gum and starch paste is an excellent adhesive. Photographs for this method of framing should be dry-mounted, or unmounted, and fixed in position on the cardboard by the top corners. "B.J.," Nov. 20, 1914, p. 859.

Staining Oak Frames.—"J. H. S." recommends as the best practical preparation for the staining of oak frames the spirit stain made by Messrs. Williams, of Hounslow, London, S.W., or the water stain of Messrs. Stevens, sold by most oil and colourmen. The most useful tints, out of the number manufactured, are brown (oak), green, and black (ebony).

For the use of the brown (spirit) stain, the powder, as supplied, is dissolved in methylated spirit, and is then applied with a paint brush, care being taken to keep on the light side, as it is very powerful and difficult to alter if found to be too dark.

This will soon dry, and is followed by a boot brush on which a piece of beeswax has been rubbed, and then by a very little "Nugget" boot black. The result is a fine art shade.

For the brown water stain, the solution should be sponged on overnight, and in the morning given a coat of French polish, and, while patchy, finished as before. Though somewhat fresher in appearance, it is very suitable for some things.

The green stain requires special treatment to get a good result. First apply a light coat of brown water stain and rub down with fine glass-paper. Then use the green spirit and again give a rubbing, finishing as above. The rubbing down brings up the figure in the wood, and fascinating results may be had if time permits.

The method found best for securing a good black stain with one coat is the following:—

Apply the green stain first to kill the wood, and if there is a tendency of the grain rising, rub down with a piece of brown paper or a hard pad. Then rub on (with a sponge) the ebony water stain, allowing ample time to dry, give a coat of polish, and again apply one of the water black. The result is a finish that will satisfy the most fastidious taste. It seems a lengthy process, but a great amount of work can be covered in a short time, owing to the ease with which the stuff may be handled. In using these stains it is well to keep on hand some putty mixed with colour of the shade required, using this mixture to stop any nail holes, and afterwards well glass papering the frame

with No. 1a or No. 0 paper. This stopping, of course, is done before staining the frame.—"B.J.," Feb. 5, 1915, p. 89.

Enlarging.

Cap for Enlarging Lantern.—In place of a loose cap for the enlarging lantern, a short stout brass tube is fixed to the lantern front a little below and to one side of the lens and projecting parallel to the lens. A second piece of tube slips over this, and to the end of the second tube is attached a wooden arm, carrying at its end a light wood frame, which will hold a piece of either yellow glass or stained thick gelatine. By turning the one brass tube round upon the other, the frame and safe filter can be swung round, either in front of the lens or away from it, as desired, catches preventing it from going too far in either direction. To start an exposure, the frame is swung rapidly away from the lens, about forty-five degrees to the right. It is then still some way from the stop catch, so the lantern is not jerked or shaken in the least. If a long exposure is required, the frame is then slowly and gently swung further until it reaches the catch, but if the exposure is short the frame is held by the hand in the place it first reaches. The moment the time is up the frame is swung back against the other catch, in which position it completely covers the lens. A slight jerk against this catch does not matter as the exposure is over. The eyes can be kept on the watch the whole time the shutter is being manipulated, and, whereas before we could not time to within one or two seconds with perfect certainty, we can now, if necessary, adjust exposure to half a second. The usual troubles peculiar to caps have, of course, disappeared also. The ordinary yellow cap goes astray in the dark. It is sometimes too tight, so that great care is required to get it off and on without shaking the lantern, while, on the other hand, it may be too loose, when it is apt to fall off the lens at very critical moments. The shutter is fixed and cannot stray. It cannot fall away from the lens, the pivot being, as explained before, fixed to one side, and it cannot jar the lens as it never touches it.—"B.J.," Nov. 6, 1914, p. 819.

W. Pearce prefers to employ, in place of the cap for the enlarging lens, a Thornton-Pickard roller-blind shutter, the length of "Antinous" release allowing of a position being taken where the watch can be conveniently seen in the red light from the side of the enlarging lantern.—"B.J.," Nov. 13, p. 844

Soft Focus Lenses for Enlarging.—"Onlooker" utters a caution as to the use of a soft focus lens in obtaining pleasingly diffused enlargements from sharp negatives. He declares that if a direct enlargement be made with the lens from a negative, the result is generally very displeasing because the enveloping secondary image is formed round the shadows instead of the high-lights. Hence, it is necessary to enlarge from a positive and to obtain the enlarged print by contact printing from the enlarged negative—"A P.," Jan. 4, 1915, p. 8.

Parabolic Illuminator for Enlarging.—F. A. Fahrenwald describes how to make a lamp for attachment to an ordinary camera in order to convert the latter into an enlarging lantern. The lamp consists of an old printing-frame to the ends of which are fixed two ends (A., fig. 1), these ends being cut of parabolic shape as explained below. A sheet of bright tin, the width of the printing-frame, is

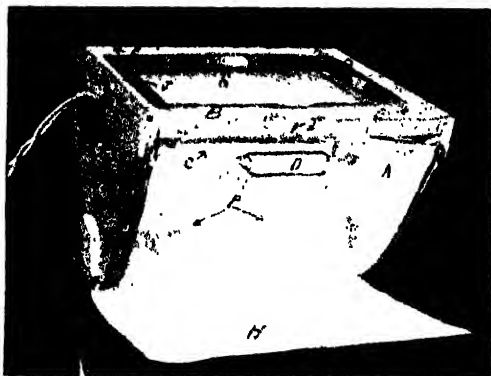


Fig. 1.

used as a reflecting surface and is given a parabolic curve by being fixed firmly on the two ends. As the source of light (F., fig. 1) two 40-watt. electric bulbs were used. D. is a small electric bulb for use as a safelight when needed.

Fig. 2 shows the parabolic curve which is used as a pattern for the end. The shape of this curve can be plotted out by rule, as shown by the following example.

Suppose that an old 10 by 3 printing-frame is available. (Any size which can best be adapted to requirements may be used in a like manner.) The outside dimensions of this frame will be about 12 by 10 ins. This gives at once 5 ins. as the value of W in the equation (below) of the parabola.

Now, if the electric bulb is 2 ins. in diameter, its centre cannot be less than 1 in. from the bottom of the curve, thus limiting f to 1 in. Solving the equation $W^2 = 4fd$, in which are substituted these values of W and f , gives $25 = 4d$, from which $d = 6.25$ ins., which is about right for this size lamp. If d comes out too deep or not deep enough, a different value for f should be chosen: the greater f the smaller d , and *vice versa*.

Having fixed the width and depth of the box, procure a piece of drafting-paper, large enough on which to plot your curve. Proceed as follows: Down the middle of the paper draw a straight line, XY (Fig. 2), and near one end of this locate a

point O as the "bottom" of the curve. Perpendicular to XY and at intervals of $\frac{1}{2}$ in., starting at O, draw the lines RS, TV, etc. These $\frac{1}{2}$ -in. intervals will serve as various values of d from which the corresponding W can be solved. Substituting these various values of d in the equation given above, it follows that

where $d = 0$, $W = 0$ = the bottom of the curve;

where $d = \frac{1}{2}$ inch, $W^2 = 4 \times f \times d = 4 \times 1 \times \frac{1}{2} = 2$;

where $d = 1$ inch (solving as above), $W = 2$ inches;

likewise

where $d = 1.5$ inches, $W = 2.45$ inches;

and

where $d = 2$ inches, $W = 2.84$ inches.

In like manner solve for points up to where $d = 6.25$ and $W = 5$ inches.

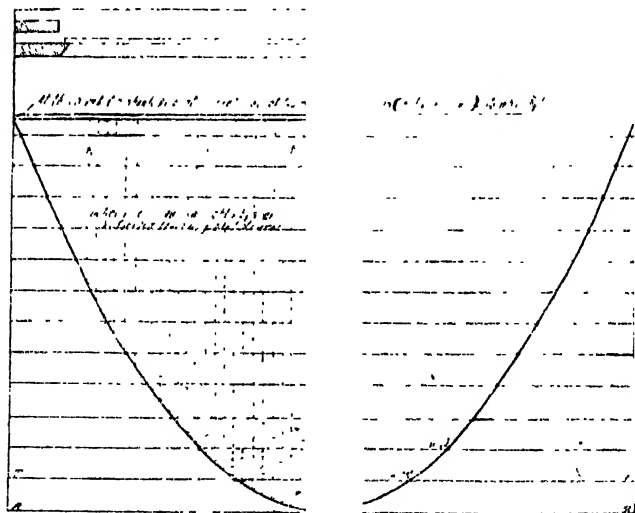


Fig. 2.

λ

Then on the perpendicular line through the point where $d = \frac{1}{2}$ in., lay off the corresponding value of W on each side of XY, i.e., 1.41 ins. each way from the axis. The two points just located are on the desired curve. Also, on the line through the point where $d = 1$ in., lay off its corresponding W value, in this case 2 ins. These points are also on the curve, and so will other points be which are to be plotted in a like manner. When

these guiding-points are located, the curve drawn smoothly through them will be a true parabola. Next lay off the focal distance F , which in this case is 1 in. This gives the point of focus F , which should correspond with the source of light.

The dotted lines of Fig. 2 show the way in which light originating at F is reflected, from any part of the curve, in a direction parallel to the axis XY . It is obvious that, with the reflector bent smoothly around the parabolic ends, every part of it will correspond with that curve, which theoretically, with a perfect reflecting-surface, should deliver one hundred per cent. of the light given out by the bulbs minus that directly towards the ends, which should be painted white. While this efficiency is by no means attained, in a lamp of such necessarily crude construction, it nevertheless furnishes the most even and intense illumination of any device, excepting the arc, that the writer has ever seen in use. "Photo-Era," Feb., 1915, p. 66.

Focus Correction with Enclosed Arc Lamp.—A method for readily finding the amount of shift required, with some lenses, when using an arc lamp of the enclosed type in enlarging, is recommended as follows by "Grandison":—Near the centre of the easel tack a small box, and then attach a strip of white card, with one end on the easel and the other end to the box; this strip will then be nearer to the enlarger at one end than at the other.

A waste negative is then scratched through the film at intervals of about a quarter of an inch and is inserted in the carrier, and the scratch coming nearest the centre of the card strip is sharply focussed. A scrap of bromide paper is then to be pinned to the card, and an exposure made and developed. After fixing, the scratch which appears sharpest on the bromide paper is noted, and the image of this mark found on the white card and marked with pencil. By then placing a ruler against the easel and across the card towards the enlarger it is easy to see the difference between the point originally focussed upon and the one found to be sharp in the print. Obviously it only becomes necessary to increase or decrease the space between enlarger and easel by just that amount. This distance will vary slightly for various degrees of enlargement, but once found the trouble will practically disappear. If the lens is changed a fresh test must be made, as the cause of the trouble is really in the lens, not in the lamp.—"B.J.," Sept. 24, 1915, p. 625.

Combined Enlarger, Dark-room Lamp, and Ventilator.—Rev. H. O. Fenton describes the facilities provided by what he terms a "light-box" in the dark-room, namely, a chamber formed by four uprights running from floor to ceiling of the dark-room so as to enclose a space about 2 ft. by 2 ft. At about 3 ft. from the floor, cross-pieces are nailed to these uprights, and boards nailed to the cross-pieces so as to form a floor. Subsequently, the portion from floor to ceiling is made light-tight by attaching two thicknesses of brown paper. On the floor (laid upon the cross-pieces), a couple of guide strips are nailed, between which a

platform can slide to and fro carrying the light for the enlarger, namely, a Howellite inverted gas-burner. A stiff wire attached to one end of this platform permits of the burner being moved to and fro from outside the "light box." Supports are also nailed to the uprights so as to accommodate and hold a field camera, such as the "Sanderson," behind the support for which is placed the condenser, and behind that a sheet of ground glass. So fitted, the "light-box" forms a convenient enlarging lantern.

The framework is also fitted with a pair of grooves accommodating three large (15 x 12) sheets of glass, one yellow, one white opal, and the third ruby. The ruby and opal yield a highly diffused and comfortable light for the development of plates, whilst the yellow and opal (without the ruby) serve well for bromides and lantern slides. With the yellow removed, the opal allows of convenient examination of negatives, etc.

The "light-box," it should be said, is erected flat against the wall, from which a brick is knocked out near the ceiling so that the box serves for the ventilation of the dark-room, the gas fumes passing off through the chamber by the outlet provided by the removed brick and thus drawing air continuously from the dark-room. It is found convenient to fix the camera and condenser on one side of the "light-box," and the ruby-yellow window on the other, the developing sink being fixed immediately below the latter. According to this plan, enlarging work is done on the right of the "light-box," and developing, etc., on the left. The whole arrangements should be convenient to those who have space which they can adapt for photographic work at very small expense.—"A. P.," Jan. 25, 1915, p. 65.

(In rooms in which uprights such as those described above could not be fitted, conveniences similar to those provided by a permanent "light-box" could be secured by using the tubular supports designed by Mr. W. H. Smith and described in the "Almanac" of 1915, p. 435.—Ed. "B.J.A.")

Finding Exposures in Bromide Enlarging.—Anketell Henderson in a paper before the Victorian Photographic Association, has described an easily worked system of finding the exposure to be given when enlarging on bromide paper by a photometric method. The system is applicable equally to enlarging both by day and artificial light. The only requisites are a scale (which can be made in a few minutes), a good candle, and a small piece of coloured glass.

It is well known that although the illumination of a surface which is given by a candle at a distance of 1 foot is 1 candle-foot, the illumination at 2 feet distance is only $\frac{1}{4}$ and at 3 feet is only $\frac{1}{9}$ th, the law being that the illumination decreases inversely as the square of the distance, so the first requisite of easy and quick measurement is a scale of inverse squares. This can be made in a few minutes on a wooden lath (such as a cloth blind lath), or on the blank back of a linen tape measure, and 3 feet 6 inches is long enough. At 1 foot from the zero end mark 1, and at 2 feet mark $\frac{1}{4}$, and 3 feet 1-9th. Fill in inter-

mediate divisions as follows:--Mark 16 at 3 inches, 9 at 4 inches, 4 at 6 inches, and 2 at $8\frac{1}{2}$ inches.

For fractions of the unit mark $\frac{1}{2}$ at 17 inches, and 1-3rd at $20\frac{1}{2}$ inches, and 1-5th at $26\frac{1}{2}$ inches, and 1-6th at $29\frac{1}{2}$ inches, also 1-7th at 32 inches, and $\frac{1}{8}$ at 34 inches, and 1-10th at 38 inches, and 1-12th at 42 inches.

A candle set at any mark will illuminate a screen set at zero, and on a white screen give a tone corresponding with that mark, and it is useful to learn to appreciate the tone values given at the different distances. A candle set at the last (1-12th) mark will give 1-12th of a unit tone at the zero end. We will use the scale first to ascertain the speed of the sensitive paper or plate we intend to use.

If we place a piece of this sensitive paper, etc., say half a quarter plate, in a printing frame at the zero end, and, by means of a card drawn along the front $\frac{1}{2}$ an inch at a time, expose it for 6 successive 2 seconds to a candle at the other end we obtain strips which have had exposures of 2, 4, 6, 8, 10, 12 seconds. The most exposed strip will receive $12/12$ —equal to 1 unit of light for 1 second, and the others respectively 5-6ths, 2-3rds, $\frac{1}{2}$, 1-3rd, and 1-6th of a unit for 1 second.

On developing this paper in the usual developer for the average time, it will show, if rapid enough, deposits of different densities, and the exposure at which the first well marked deposit appears can be taken as the speed of that paper in candle foot seconds. For this speed the term "inertness" is suggested. Practically 1-12th of a second exposure at 1 unit distance may be taken as equivalent to 1 second exposure at the 1-12th mark, and so on.

It is rare to find a bromide paper so slow as 1. The usual rapid paper is $\frac{1}{2}$ to 1-3rd, and extra rapid may go to 1-6th or $\frac{1}{8}$.

Should the paper speed be known to be slow, better perform the operation at mark 1-6th and give successive exposures of 3, 3, 2, 2, 2 seconds, which will correspond with speeds of 2, $1\frac{1}{2}$, 1, 2-3rds, 1-3rd units. As experience is gained the exposures at mark 1-12th can be made successively 3, 3, 2, 1, 1, 2, which will correspond with exposures 1-6th, $\frac{1}{2}$, 1-3rd, $\frac{1}{2}$, $\frac{1}{2}$, and 1 unit. This test of speed can be made, including development, in about 3 minutes.

It is a good practice to test a sample of all new papers bought and endorse the speed or "inertness" on the packet or box. Remember that the speed of a paper diminishes with age after the packet is opened, and, in using an old paper, treat it as one of reduced speed.

When enlarging, we obtain projected on the easel an image of the negative in varying tones like those produced by a candle at different distances. The darkest of these tones, as a rule, should not produce a visible deposit on the sensitive paper or plate: the second darkest should produce a visible deposit. Having measured the speed of the paper, as just described, we proceed to measure, say, the darkest tone on the easel. This is very simple, and it is best to start with a very thin negative.

Hold a thin pencil or pen-holder about $\frac{1}{2}$ in. in front of the darkest tone on the easel, and it will cast a dark shadow on that

portion. Now cast another shadow adjoining it by holding a lighted candle at one side of enlarging lantern. The first shadow will then be illuminated by the candle, and the second shadow will be illuminated by the darkest tone of the negative. Move the candle nearer to the easel, or further away, until the two shadows are of equal intensity or tone, and measure with the scale from zero to candle. With the thin negative this will generally be within the limits of the scale 1/12th, but with a dense negative the distance of the candle might be inconvenient and difficult, being excessive.

Another difficulty is that the colour of the two shadows are generally different, the shadow illuminated by the candle being more yellow or brown than the other. Both difficulties are got rid of in the simplest way. Alter the colour and reduce the light of the candle by interposing between it and the easel a light blue glass, which will only pass a fraction (a good proportion is 1/10th) of the light. This will get rid of the colour difficulty and lessen the distance of the candle from the easel, and enable very dark tones to be measured.

If the blue glass passes 1/10th of the light, the 1/12th mark will become equal to 1/120th. The writer has a few old negatives for which he requires glasses as dark as 1/20th or 1/30th, which makes the range of the scale 1/240th and 1/360th.

Supposing the darkest tone on the easel to be 1/60th unit, and the speed of the sensitive paper 1/3rd, the relationship of these two numbers will be 20, and 20 seconds exposure for the enlargement will just give a marked deposit after development, provided that the actinic or chemical power of the lantern light is the same as the candle used for testing the paper. Generally it is greater, but not so much greater as the difference in colour would indicate, for much of its actinic power is absorbed by the condenser and lens. A deduction of $\frac{1}{6}$ to 1/10th of the calculated exposure, say, from 20 to 18 units, was found to suit a lantern with inverted gas-mantle.

So far we have assumed that we measure the darkest tone, and that a marked deposit is required in the enlargement to correspond with that tone. If white is required for that tone, we must measure the second darkest tone, or make a further allowance, such as a deduction of 1/16th or 1/5th from the calculated exposure for the darkest tone. One trial with an average negative will give confidence, and indicate the allowance to be made. These methods of measurement are not nearly so difficult as they read, and once mastered the only difficulty in enlarging is choosing or obtaining paper of the proper gradation to suit the negative. This is common to all methods of enlargement--a thin negative generally requires a slow paper, and a dense negative a rapid paper.

To ascertain the value of the blue glass, set the candle with the blue glass at mark 2, and with pencil or penholder cast a shadow on a white screen at zero. Cast another shadow adjoining it by a similar candle without blue glass, and move this candle nearer to the screen, or further away, until the two shadows are of equal intensity or tone, and note the mark on the scale. Suppose the mark

be 1-5th, the relationship of the marks will be 10, and the blue glass will transmit 1-10th of the light. If the mark be 6, the relationship will be 12, and the blue glass will transmit 1-12th. Change the candles, and test again, and adopt the mean of the measurements. For darker blue glass set the candle with the blue glass at mark 4.

For testing the speed of papers in the printing frame, a glass front is required, and it is an improvement to gum a strip of black paper about $\frac{1}{4}$ inch in width along the centre. Discoloration behind this strip indicates that some, or more, restrainer in the developer is necessary with that paper. It is a still further improvement to make a printing frame into a rough dark-slide as follows:—Along the two sides of the frame glue $\frac{1}{2}$ -inch strips of thick card about $\frac{1}{10}$ th of an inch thick and on these, $\frac{1}{4}$ in. strips of the same thickness. Upon the latter strips the glass front will rest, and between them a thinner card will slide as a shutter. Rule lines $\frac{1}{2}$ inch apart on this shutter.

To hold the blue glass some form of lantern is convenient. A tin lantern for candle costs about 9d., and will hold a $\frac{1}{4}$ plate of blue glass, and one of orange. The latter is useful in a developing room.

As to candles. Select a brand that gives a uniform flame. You need not go to the expense of standard candles. A sample of stearine small carriage candles, 12 to the lb., gives a most uniform flame.

Lastly, you do not need to measure for every enlargement. You will soon get to appreciate the values of the various tones, and need only measure at the commencement of a batch, or for unusual negatives.

All bromide papers tested have sufficient latitude to give good results notwithstanding small variations in the light given by commercial candles. —“B.J.,” July 9, 1915, p. 448.

Working Up Photographs.

A Little-Known Method of Oil Colouring.—J. Peat Millar recommends for the use of those who would employ ordinary oil colours in the same way that tinting dyes are used, the process in which the colours are applied with a piece of fine white cloth stretched over the forefinger, or for very fine work, a piece drawn tightly over a leather or paper stump, or even a piece of soft wood. The results obtained necessarily vary according to the ability and taste of the worker, but it is so simple that even the least experienced can obtain a quite passable result. The most suitable papers for colouring in this way are those with a semi-matt surface, though a matt surface can be used if there is a good coating of gelatine to work on. Rough surface papers, however, do not give good results, as the colour is apt to gather in uneven patches and so cause a dirty looking result. Strong brilliant prints are best, not hard, but clean and bright, with well marked gradations, as the photographic image has to show through the

colouring and supply the light and shade. Glossy papers can be used, but the colour does not adhere so well as on a good hard-surface matt paper, and is more easily rubbed off while wet.

The secret of success lies in the ability of the worker to leave just as much colour as will give the desired tint and no more. The result should be a coloured photograph, similar in appearance to one which has been stained with aniline dyes, but with this difference, that, if the best oil colours have been used, the tints will remain for a long time with very little change, probably as long as the photograph will last. To read these directions may make the procedure sound very tedious, but in practice quite a number of prints can be done in the time it takes to write about one. An enlargement from 15 x 12 to 20 x 16 can be finished in this way in from an hour to an hour and a half, and smaller sizes much more quickly, a print of cabinet size taking only from five to ten minutes. Of course, the results obtained are not in any way to be compared to a good oil painting, but anyone who masters the rubbing on process is in a fair way to be able to master the art of finishing in oils and producing what is known in most studios as oil paintings with a photographic base. As a matter of fact, after all is done which can be done by rubbing on, it often requires very little brush work to make the result as good as many of the so called oil paintings which one sees on the market. Some might even say they were better on account of the more faithful likeness, for by the rubbing-on process of applying colour the likeness is never altogether lost, but the same can seldom be said of those done with the brush -- "B. J." Jan 1, 1915, p. 8.

Permanence of Colour Pigments. -- Sir William Abney, in a paper before the Royal Society of Arts, has shown that exposure to ozone forms a reliable test for the stability or otherwise of the pigment towards light in the course of years. He tested a long series of pigments and found that the order of permanence towards ozone (exposure of few hours) practically coincided with the order obtained by exposure to light for nearly two years. As in the case of daylight, it was found that fading did not take place unless moisture was present. As an amateur water colour painter Sir William Abney has used the following fourteen colours as the most permanent obtainable.

Vermilion	Lemon yellow
Light red	—
Rose madder	Emerald green
—	Viridian
Aureolin	Hooker's green
Yellow ochre	(a new mixture)
Raw sienna	Sunny green
Cadmium yellow	Cobalt
Madder yellow	

—"Journ. Soc. Arts," Dec. 18, 1914, p. 85. "B. J.," Dec 25, 1914, p. 933.

Scraping Spots from Prints.--It frequently happens, after scraping black spots from rough surface prints, that a small hole appears, which shows badly in an opposite lighting. To remedy this, touch with a little white starch, dissolved in water. Two or three applications (allowing each to dry) should bring up to surface level, after scraping surplus starch away very gently with flat edge of knife. If the spot appears too white and glaring, tone down with colour. This plan saves many a good print otherwise rejected.--"B.J." Oct. 16, 1914, p. 777.

Lantern Slides.

Binding Lantern Slides.—P. Dinsley finds it best to lay the gummed binding strips gummed side up on a pad of wet blotting-paper for a few minutes, without otherwise moistening the gummed side. This gets the adhesive into just the right condition, and the paper itself lies flatter on the glass than if it is put down immediately after being wetted. The two opposite sides are always bound first and allowed to get thoroughly dry before the other two are bound. When a number has to be done, it is best to bind all of them on two sides one evening, and then to bind the other two the next night. When binding the second pair of slides, a drop of gum may be placed at the corners where the second binding comes on the first, as this is where there is the greatest tendency for the binding to come loose when often put through a lantern.--"Photo." Oct. 23, 1914

Panchromatic Negatives for Lantern Slides to be Coloured.—In a paper before the Royal Photographic Society, R. Malby has insisted on the necessity of using a panchromatic plate and suitable screen when making negatives from which slides were to be prepared and to be coloured. As compared with slides from negatives on ordinary plates, such positives were exceedingly transparent in the right places and, therefore, were susceptible of being coloured by tinting dyes to yield slides of extreme clearness and brilliancy of colour. Mr. Malby employed the aniline tinting solutions of Messrs. Johnson, applying them on the dry gelatine slide with small sable brushes and allowing one portion to dry before proceeding to colour adjacent parts.--"Phot. Journ.," Feb., 1915, p. 72.

Fish Glue Lantern Slides.—J. J. Robinson has patented the use of a mixture of fish-glue, 6 ozs.; water, 10 ozs.; and ammonia bichromate, 1 oz., as a sensitive coating for preparing indestructible slides on mica for cinematograph projection. The chemicals are mixed together, filtered and poured over the sheet of mica. The mica is then dried over a gentle heat, and printed from the negative with the uncoated side in contact with the negative. It is well washed in warm or cold water, after which it is placed in a solution of dye, and if satisfactory it is dried off and raised to a temperature of 700 degrees F., which has the effect of burning the image permanently on to the mica.--Eng. Pat. No. 24, 103, 1913 "B.J." Jan. 22, 1915, p. 58

Projection Screens.—During the course of the past twelve months a number of patents have been taken out for the preparation of projection screens serving to yield a brighter image than the ordinary matt white screen. These screens are primarily intended for use in cinematograph projection where the illumination is comparatively feeble. It may be seriously doubted whether some of the "inventions" are of any use for the purpose.

E. G. Medway and the British Patent Surbrite Co., Ltd., coat canvas with a mixture of a metallic powder, such as nickel powder, and a crystallisable substance, such as naphthalene, by mixing these two substances in rubber solution. They recommend 2 lbs. of nickel powder and $\frac{3}{4}$ lb. naphthalene dissolved in rubber solution to make one gallon, the rubber solution being composed of rubber 23 ozs. to naphtha 160 fl. ozs.—Eng. Pat. No 22,774, 1914. "B.J." Feb. 26, 1915, p. 138.

J. T. Hodgkiss coats canvas with ordinary white-lead paint, giving two coats and then a coat of gold size mixed with plain linseed oil and turpentine. Whilst this coating is still wet, aluminium powder is dusted on evenly over the whole surface, preferably with badger-hair brushes. The coating is then left to dry, excess of aluminium powder wiped off with silk pads and the surface then given a protective coating of a mixture of equal parts of white of egg, isinglass and parchment size.—Eng. Pat No. 12,658, 1914. "B.J." March 12, 1915, p. 169.

F. Butterworth prepares a coating for fabric consisting of a mixture of wood pulp with granulated or pulverised glass.—Eng. Pat. No. 13,146, 1914. "B.J." July 9, 1915, p. 451.

A. D. Buxey has patented a projection screen (to be placed between the observer and the lantern) which essentially consists of the mosaic starch grain colour screen of the Autochrome plate without the emulsion coating. It is claimed that such a screen is non reflecting, is free from the intense brilliancy of ordinary projection (in the dark), and serves to exhibit the picture in broad daylight equally well.—Eng. Pat No 8,805, 1914. "B.J." Jan. 8, 1915, p. 27.

H. W. C. Williams coats the screen with luminous paint, his object being chiefly to diminish flicker by providing a faint general illumination of the screen during the intervals when the shutter of the projector is closed.—Eng. Pat. No. 10,276, 1914. "B.J." Feb. 26, 1915, p. 138.

Cinematography.

(Space will not permit of reference to the numerous patents for cinematograph cameras, projectors, and films for animated photography in monochrome and natural colours. The specifications are published or abstracted in "The British Journal of Photography," and entered in the annual index of that publication under (1) Cinematographs and (2) Name of Patentee).

VI.—COLOUR PHOTOGRAPHY.

Patents for Colour Photography.—The chronology of the patent specifications relating to colour photography commenced in the monthly "Colour Photography," Supplement to the "British Journal of Photography," Jan. 4, 1907, is concluded with the issue of Dec. 6, 1907, p. 96. All current patents are dealt with week by week in the "British Journal of Photography," and are entered in the annual index under (1) Colour photography and (2) Name of patentee.

Two-Colour Processes.

Kodachrome Portrait Colour Transparencies.—In a communication from the Eastman Research Laboratory before the Royal Photographic Society, particulars are given of this new method of producing portrait transparencies in natural colours. The method is a two-colour one, but unlike two-colour additive methods, as used in projection and cinematography, it is found that the two colours need not be almost exactly complementary to each other for the reason that, in a subtractive method, the whites are obtained by the absence of either of the colours, whilst in the case of full black the colours are of such strength that almost any colour is satisfactory. Thus, while it is not claimed that the method equals in its results a three-colour process, theoretical considerations indicate that the results should be better than by a two-colour additive process, and would probably be sufficiently pleasing for most purposes.

In the Kodachrome process two negatives are made, one through a red and one through a green screen. These negatives are converted, after development and fixing, into dyed positives, that taken through the red screen being converted into a green positive, and that made through the green screen into a red positive. The two are then superimposed to form the complete colour transparency. It is not necessary to use the original negatives. Duplicate negatives can be made and treated in the same way, in which case control of the colour values can be exercised in the way of retouching, local reduction, etc.

The process, as placed upon the market in the United States by the Eastman Kodak Company, is designed specially to render the colours of flesh and hair in portraiture. Blues, violets, magentas, and purples are not correctly rendered by the process.

Light blues appear blue-green, and violets, black; magentas appear pink; and purples, dark brownish-red. On the other hand, flesh tints of all kinds, and all shades of red, orange or green, greys

and blacks, are well rendered. As these are predominant in portraits the results are very satisfying for this class of work. Many of the pictures appear to show blues.

The negatives are made (on panchromatic plates) preferably by an artificial light system, such as a cluster of twelve half-watt lamps. A camera may be used by which one of the negatives is made reversed compared with the other one, so that when the two plates are put face to face they will register; or the pictures may be made in an ordinary camera to which a repeating back has been fitted, carrying the two filters and plate holders, so that first one picture can be taken, then the back slid along and the other picture taken at once. This camera enables the two exposures to be given very rapidly one after the other, the total exposure, using the powerful artificial light which has been adopted, being only about three seconds. Great attention to detail is necessary in the process if the best results are to be obtained.

The finished transparencies are best shown by artificial light. Illuminating frames have been designed which are little more bulky than ordinary picture frames, but provide very effective and even illumination of the transparencies by means of a small electric bulb, the light of which is diffused through sheet opal.--"Phot. Journ.," April, 1915, p. 140. B.J. "Colour Photography" Supplement, May 7, 1915, p. 17.

The official instructions for working the Kodachrome process are given with some abridgment in B.J. "Colour Photography" Supplement, May 7, 1915, p. 17.

Colour Transparencies.---W. F. Fox, W. H. Hickey, and the Kinemacolor Company of America have patented methods of producing colour transparencies for projection by taking in the first instance colour-sensation negatives through a green and a red filter. The negatives are developed and a positive printed from each. The green filter negative is then brought in register with the positive from the red filter negative. Likewise the red filter negative is brought in register with the positive from the green filter negative. Then from the superimposed negative and positive films a printing negative is produced, preferably on similar material, using, however, but one of the two superimposed images upon the combined negative and positive. . . . Using the printing-negative above described, a positive print is produced, which, particularly if designed for use as a transparency or for projecting purposes, may be upon film of the same general character as the positive print made from the original negative. The print made from the printing-negative (and termed the "projecting-positive") is then subjected to the colouring step.

The projecting-positive is subjected successively to baths, one (and preferably the first) of an acid green, and the other an alkaline red. Unless the acid constituent of the green be of such character as to make the silver deposit upon the film absorptive, this should be done by immersing the film, prior to the colouring step, in a bath of vanadium chloride or other suitable acid. In either event, after

immersion in the green bath, the film is preferably washed before being subjected to the red bath.

The print resulting from the practice of the steps above described will embody approximately the colours which characterise the image originally photographed, and, as such, is capable of use in any known manner, as, for instance, by projection through a suitable lantern or consecutive view apparatus. Under this invention, however, a more perfect reproduction of the original colours, with respect to suitable and harmonious blending and gradation, can be obtained by carrying the process above described two steps further, as follows:

The coated surface of the projecting positive is first varnished, and over such varnish the surface is re-emulsified, or, in the alternative, such surface is rendered waterproof and the reverse surface of the film emulsified.

Next there is printed upon the projecting-positive, successively, each of the two images upon the original negative, one of these, as above stated, having been taken through a green filter, and the other having been taken through a red filter. In successively printing these original negative images care is taken precisely to superimpose each of the negative images upon the positive-image. After this operation it only remains to develop and fix these two additionally printed images upon the projecting positive. As a result of the two last steps above stated, the colouring upon the image of the projecting-positive is perfected with respect to colour gradation, as above explained.

Good results may be obtained by immersing the projecting-positive, after inprinting thereon from the printing-negative, in a bath, which will have the effect of turning green, in varying degree, the silver deposit of the image. Such a bath may be compounded as follows:—

Vanadium chloride	20 grs.
Ferric ammonium oxalate	10 grs.
Ferric chloride	10 minims
Potassium ferricyanide	20 grs
Glacial acetic acid	10 minims
Oxalic acid	100 grs.
Water	to make 20 ozs.

After immersion in this bath for a short time, the film may be washed to remove surplus materials. Eng. Pats., Nos. 552 and 3,728, 1914 "B.J." Jan 1, 1915, p. 13.

Three-colour Processes.

Raydex Colour Prints.—Vivian P Davis gives a number of hints on the working of the Raydex process of making three-colour prints. It is in making the bromide prints or enlargements that the final result can be chiefly controlled. A full exposure should be given and a weak developer used, say the Raydex one-solution developer, 1 part in 40 parts of water. For landscape subjects the print or

enlargement to form the red image should generally be taken out of the developer before the other two.

In squeegeeing the bromide to the "sensitized" colour sheet, the latter is raised by one corner and allowed to drain. The bromide is laid face up on a sheet of glass which is held in the left hand so that the thumb comes over the edge in the middle of one end. The bromide, mounted in this way, is given a dip in water and the colour sheet then laid on it, quickly bringing the edge of the colour sheet under the thumb, level with the edge of the glass. Still holding the colour sheet with the thumb in a central position, two or three steady strokes with a roller squeegee are given, first in one direction and then the other in order to ensure good contact. - B.J. "Colour Photography" Supplement, January 1, 1915, p. 1.

The Hesse Three-Colour Process. Working directions are given for the making of three colour prints and transparencies by the Hesse process worked out by Mr. F. E. Hesse and marketed by the Hesse Ives Corporation of Philadelphia. According to this process the three negatives are made in two exposures, the three plates being handled as one unit in development. In making transparencies the three negatives are exposed together, whilst for the production of paper prints a special paper is used for the blue component of the trichrome prints. - B.J. "Colour Photography," Supplement, September 3, 1915, p. 34.

Electro Magnetic Air Spray Three Colour Process. B. Boubnoff has patented a complex three colour process in which air sprays (of colour) are controlled by electro magnets, which, in their turn, are caused to vary in strength of field through the means of a relief print, prepared from the original screen plate negative, and representing in relief the light and shade of the subject. Eng Pat No. 24,119. 1913. "B.J." Jan. 22, 1915, p. 59.

Raydex Three-Colour Prints. - J. C. Arch, in an article dealing with various details of the Raydex three colour process on paper, notes that when a set of bromide prints is redeveloped and used a second time, that the prints are different from the first, sometimes more and sometimes less dense. It is impossible to tell from the redeveloped bromide what the second set of colours will be like: the chemical action not always being the same. If, however, the bromides are treated as follows, the second prints will vary from the first only very slightly.

Place the bromides, after stripping, into a used sensitising bath, so that the bleaching action is completed. Then well wash for about fifteen to twenty minutes. Redevelop them in the re-developer sold for the purpose. Leave them until development is complete - ten minutes is not too long. Wash again for ten minutes, then place for five minutes into a solution of hydrochloric acid, 1 part to 40 parts of water. Again wash for a few minutes, then put into a used developing solution for two minutes. It does not matter how old the developer is. Give a final wash for fifteen to twenty minutes, then dry. Prints treated in this way will give

three or four prints almost alike. They must, of course, be treated every time they are redeveloped. B.J. "Colour Photography" Supplement, July 2, 1915, p. 25.

One-plate Three-colour Processes.

PROCESSES OF PREPARING SCREEN-PLATES.

Under this heading are described processes the products of which at the time of writing (Sept., 1915) are not on the market.—Ed., "B.J.A."

Colour Screen Plates.—J. Rheinberg has patented a method of preparing colour-screen plates, the essential feature of which is that the whole surface is covered with the vehicle of the resist, and chemical changes are caused to occur in the resist by the action of light, which alter its permeability to solvents. The dyes are then extracted from the underlying film, or the underlying film dyed up without any removal of the superimposed resist. Moreover, frequently the resist is composed of similar substance to that of the underlying film.

The materials employed in carrying out the method and the series of operations required are perhaps best indicated by quoting from the specification the manipulation required in making a three-colour screen of red-green and violet elements in which the red and green are in the shape of rectangular dots and the violet element in lines, each of the three colours occupying an equal area of the whole surface.

1. Coat a plate with collodion dyed red, and having an albumen resist on it, which resist is sensitised by immersion in water containing $7\frac{1}{2}$ per cent. of green ferric ammonium citrate and $7\frac{1}{2}$ per cent. uranium nitrate.

2. Expose the plate to light under a line screen having, say, 200 opaque lines and 200 clear lines per inch, the opaque and the clear lines being of equal width.

3. Immerse the plate in acidified alcohol and extract the red dye from the parts of the collodion film corresponding to the clear lines, through the albumen resist. The plate will now have 200 red lines and 200 clear lines per inch.

4. Next immerse the plate for a short while in an alcoholic solution of a green dye, by which means the clear lines of collodion become green, the red lines remaining as they were. The green and red dyed portions now occupy half the total area of the plate.

5. Next wash the plate in water, which removes the water-soluble chemicals in the resist.

6. Sensitise the resist in the same solution used previously.

7. Expose the plate to light under a line screen having 200 opaque and 200 clear lines per inch, the opaque lines being twice as wide as the clear lines. The line screen is placed at right angles to the red and green lines already on the plate during exposure.

8. Again immerse the plate in the acidified alcohol solution and extract the dyes from the collodion film corresponding to the clear

lines of the line screen, through the albumen resist. This will leave the plate with red and green rectangular elements and with clear lines. The clear lines will occupy one-third the area of the plate, as they were only half the width of the opaque lines in the line screen. Consequently the red and green rectangles left in the collodion occupy two-thirds of the area of the plate conjointly, or one-third of its area each.

9. Immerse the plate for a short while in an alcoholic solution of a violet dye, thereby dyeing up the clear lines and leaving the red and green rectangles unaffected. The plate is now complete.

10. Now, if desired, completely remove the whole resist, by means of warm water, or water to which a little acid or alkali has been added, leaving the film containing the colour elements clean and free.

In place of resensitising the same resist as in operation (5) it is sometimes advantageous to remove it altogether at this stage, and to recoat with a fresh resist which is then sensitised and the subsequent operations proceeded with.—Eng. Pat. No. 9,929, 1914, "B.J.," July 2, 1915, p. 433

Colour Sectional Screen Plate.—C. L. A. Brasseur has patented a colour-screen plate made by assembling threads or filaments containing the different colours required and compressing the bunch of these latter. Thin sheets are then cut across the length of the threads as by a veneer machine. The threads used in the process are cut from sheets of celluloid or analogous plastic material, or products having cellulose acetate as a base, as great regularity of section, and, therefore, of coloured area, is obtained. The threads can be grouped in sets of three different colours by winding them together, or better still, three thin sheets of the plastic material can be cemented together and then be cut into threads, each thread showing a section of three differently coloured areas. If now either the triple-coloured threads, or composite threads made up of a larger number of individual threads than three, or of a number of triple colour threads, are cemented together lengthwise and pressed under appropriate conditions, a solid block of plastic material will be obtained which has only to be cut in a veneering machine, at right angles to the direction of the threads, to obtain sheets composed of the differently coloured areas practically uniformly distributed.

The supporting film may be colourless, or it may have incorporated in it the light orange colour which is generally used to equalise the times of exposure under the three colours. In the latter case, when working under the same conditions of light, it will be possible to obtain correctly coloured negatives without using a separate orange coloured screen at the lens.—Eng. Pat. 28,631. 1913, "B.J.," March 5, 1915, p. 155.

Screen-plate Colour Film.—J. E. Thornton has been granted patent rights for various methods of producing screen-plate colour film, including application of the colour elements to the celluloid by

means of intaglio engraved plates. Eng. Pat. 14,145, 1914.--"B.J." Aug. 6, 1915, p. 517.

Registering Colour Screen Plates.—F. H. Stevens has patented an appliance for holding the positive and the viewing-screen in contact whilst providing means for moving them both longitudinally and angularly in order to secure registration. Details and drawings of this patent (No. 2,975, 1914) are given in "B.J." Feb. 12, 1915, p. 105.

SCREEN PLATES ON THE MARKET

THE LEMIERRE AUTOCHROME.

Developing Autochromes.—B. J. Sheehan recommends as the outcome of trying many developers the original metoquinone. He desensitises the plate by immersion for a few minutes in a solution of potassium bromide, 110 grs.; soda bisulphate, $\frac{1}{2}$ oz.; water, 25 ozs. (as first suggested by M. Dillaye, "B.J.A.," 1913, p. 700). After desensitising, the plates can be developed in a deep ruby light or by a Virida light composed of two thicknesses of green and three thicknesses of Virida paper. In place of exposure to daylight before redevelopment he prefers to expose the plate about a foot away from the light of a 100 watt tungsten bulb.--B.J. "Colour Photography" Supplement (from "American Annual of Photography"), April 2, 1915, p. 15.

Sunrise and Sunset Autochromes. A. E. Morton describes the methods successfully used by Ellis Kelsey in making Autochrome transparencies of sunrise and sunset subjects. For good Autochromes of these effects there should be clouds travelling between the horizon and the camera, and the sun should be a few degrees above the horizon, but hidden, at the time of exposure, behind the clouds, otherwise a flare spot is caused. Exposure meters are of little use. It is best to judge the exposure by allowing for the sun's altitude. The best view-point is one giving a level horizon and with water in the foreground. The latter makes the subject easier, whereas with a strong foreground the exposure has to be longer and a smaller stop ($f/3$ instead of $f/4$) requires to be employed, thus depriving the foreground of the luminosity which plays a large part in obtaining a pleasing effect. Where necessary, the foreground may be shielded by holding a card, covered with black velvet in front of the top part of the lens for a portion of the exposure, moving it up and down slightly to avoid a hard line. Exposures range from four to eight seconds for the sky and from five to twenty times the sky exposure for the foreground. It is best to err on the side of over-exposure. A developer found suitable is Rodinal of 1:20 or 1:30 strength.--B.J. "Colour Photography," Supplement, Dec. 4, 1914, p. 47.

Pure Whites in Autochromes. For securing pure whites in Autochrome transparencies, Adam Black recommends the use of a bichromate instead of a permanganate reversing bath; also the

keeping of the plates for a time between exposure and development. If the greatest purity of the blues is aimed at, the plates should be developed as soon after exposure as possible.—"B.J." *Colour Photography Supplement*, Sept. 3, 1915, p. 36

Exposure and Development of Autochromes. E. A. Biermann, in a paper before the Birmingham Photographic Society, dealt with the methods of exposure and development found best in experience in making Autochromes of specially difficult subjects, such as finished motor cars and other articles of manufacture. Adopting MM. Lumière's standard of exposure—viz., 1 sec. at $f/8$ in good light with a normal subject, he had found that the increased exposure for each reduction of the diaphragm worked out at $2\frac{1}{2}$ times whatever the actine strength of the light; that is to say, if at $f/8$ the exposure required was found to be 2 seconds, then at $f/11$ this would be 5 seconds, at $f/16$ $12\frac{1}{2}$ seconds, and so forth.

The same rule also applied to the actinometer values. If an actinometer light test of 3 seconds indicated an exposure of 1 second, a test of 12 seconds would indicate an exposure of $6\frac{1}{4}$ seconds, instead of 4 seconds, as in ordinary practice.

The subject values are also important. It seems hardly possible to obtain good Autochromes even of distant subjects with less exposure than half-normal, and near subjects, of course, require double normal. For interiors, normal exposure for general views and double for near objects practically covers the ground, very near objects, photographed to a relatively large scale, being separately considered on their merits, using the near position as a basis.

As regards development, Mr. Biermann had found that the maker's prescription of 2½ minutes' time of development with a 1:4 Quinomet developer tended to over-develop the bright high lights; it was found necessary to graduate the strength of the developer according to the brightness of the subject. An average strength of the developer was 1:8. One of 1:4 strength was used only for very dark subjects and interiors or for known under exposure. For subjects in the brightest sunlight and those of an open character the best strength was 1:10. For subjects without sunshine 1:6 was a good strength; 1:8 for those in diffused sunshine.

In practical development work he adopted a modified factorial system. Working with a green safe light, he poured on the Quinomet solution and began to count seconds. At the first sign of image showing, ignoring the sky in landscape subjects, he covered up the dish, squared the time of appearance, and multiplied the result by four. Thus—first appearance, 6 seconds; time of total development, 2 minutes 24 seconds; that is to say, 6 multiplied by 4 equals 36, multiplied by 4 equals 144 seconds, or 2 minutes 24 seconds.

If the first appearance were longer than 15 seconds, then it was a sign of under exposure, and the proportion was to be increased to 1 of Quinomet to 4 of water, and the development continued for 15 minutes. It is only by the above method that one could be tolerably certain of obviating the hard and metallic greens and securing the true blue and white skies.

Immediately after the first development the plate should be placed for two minutes in the alum bath (saturated solution) when the white light might be safely turned on. The plate should then be rinsed well for one minute before placing in the reversing bath, after which, and once more well rinsing it was again hardened for two minutes in the alum bath as developed and washed for five minutes.

For the reversing bath Mr. Bickmann did not adopt the usual acid permanganate but preferred bichromate. He gave his formula for this as: Potassium bichromate 2 grains sulphuric acid pure, 4 minims, water 1 oz.

Two most essential points he insisted upon in the above process were—firstly the alum bath after first development and secondly washing the plate thoroughly afterwards. To take all precautions against the risk of burning a blistering, the method of washing was also important. Do not soak the plate in still water urged Mr. Bickmann but rather wash with a gentle stream of water running over its surface. B. J. Colour Photography Supplement January 1 1915 p. 2.

Exposure Meter for Colour and Orthochromatic Plates. R. B. Donohy has described a compact dial for use with the Wynne-Hunter exposure meter by means of which no changing of dials is necessary when using both ordinary and colour plates when in the field. This convenience is secured by having the dial transparent.

To make this improvement take off the dial of the meter and remove the varnish from the centre of the fixed disc thus exposed.



Fig. 1

Instructions for the Dial in the Wynne-Hunter exposure meter.

Draw three circles 95 mm, 65 mm and 40 mm diameters lightly in pencil on the cleaned surface. Using the outer scale divisions as a guide, draw twenty-four radial lines between the two outer pencil

circles, forming twenty-three spaces, which will thus correspond with the spaces on the outer scale. Commencing with the space opposite 64, number the spaces as follows —

130, 85, 55, 35, 22, 14, 9, 6, 4, $2\frac{1}{2}$, $1\frac{1}{2}$, 1, 2, 3,
 $\frac{3}{8}$, $\frac{1}{4}$, $\frac{1}{6}$, $\frac{1}{9}$, $\frac{1}{14}$, $\frac{1}{20}$, $\frac{1}{30}$, $\frac{1}{50}$, $\frac{1}{80}$ and $\frac{1}{120}$

This is the actinometer and exposure scale for colour plates

The lines of this scale between 22, 14, $4\frac{1}{2}$, $1\frac{1}{2}$ and $\frac{1}{2}$, are prolonged to meet the smallest circle and + 2, $1\frac{1}{2}$, + 1, and + $\frac{1}{2}$ written in the spaces formed, to act as a light value scale.

It is best to use red waterproof drawing ink for these new scales. When the ink is thoroughly dry the pencil lines may be carefully erased with soft indiarubber and the disc varnished with celluloid varnish.

If any difficulty is experienced in marking the scales on the celluloid surface they may be drawn on paper cemented into place, and then varnished. The disc with the added scales is shown in Fig. 2.

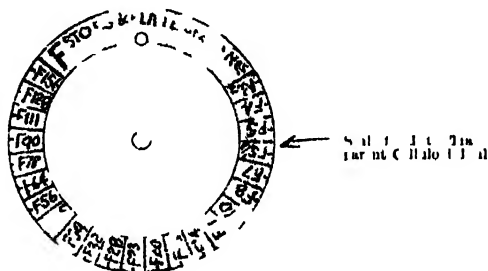


Fig. 2

The dial is made by copying the Wynne primary 1 scale in black ink on an annular piece of paper 14 in. outside and 1 in. inside diameter. This is cemented with celluloid varnish to a circular piece of transparent celluloid 14 in. diameter by about .02 in. thick.

Two holes to take the pivot stud and knob for turning, complete the dial—see Fig. 2—which can now be snapped into place. It will be noticed that all the scales on the fixed disc are visible.

When using the meter for ordinary plates the two scales in black are used in the ordinary way.

For colour plates when the light is strong enough to darken the paper to full tint in less than one quarter of a minute the speed number of the plate Autochrome I 14, Paget I 20 is set against the actinometer time on the red scale and the correct exposure read off opposite the stop used.

The light value scale indicates the number of spaces the speed number of the plate must be set forward when the actinometer time counted in minutes, comes within the limits shown thus making

allowance for the much slower action of poor light upon colour plates.

The following examples will make the use of this scale clear:—

(1) Autochrome plate.—Actinometer time, 22 sec. = $\frac{2}{3}$ min. Light scale opposite $\frac{2}{3}$ shows + $\frac{1}{2}$. Set F. 14 on dial half a space forward—i.e., between 22 and 35 on the colour scale and opposite the stop used, say, F. 8, which is midway between 6 and 9—count the exposure as $7\frac{1}{2}$ sec.

(2) Autochrome plate.—Actinometer time, 35 minutes. Light scale opposite 35 gives + 2. Set F. 14 on dial two spaces forward of 35—that is, opposite 85 on the colour scale—and read the exposure for a stop of F. 8, as 22 min.

The new scales are as simple to use as the ordinary ones, while the advantage of having all the information on the meter, leaving only the plate speed number to be remembered, greatly lessens the difficulty of exposure with colour plates. B.J. "Colour Photography" Supp., Aug. 6, 1915. p. 32.

COLOUR PRINTS FROM SCREEN PLATE NEGATIVES.

Screen Plate Colour Prints.—J. and E. Rheinberg have patented a process for the production of colour prints on paper by a screen-plate process from negatives likewise exposed in the camera through a mosaic colour screen. In the production of the positive print another colour screen is employed (the viewing colour screen) which may be on a transparent or opaque foundation, and which is covered with fine dots or lines in the same regular pattern as that used for the negative, so that it registers with the same, but in which the colours are of the kind used in subtractive colour mixing—namely *minus* red, *minus* green and *minus* blue; in other words, greenish-blue, magenta, and yellow respectively.

The fact of the colours used being those ordinarily employed for subtractive colour mixture does not in itself condition that the screen acts according to that principle, in fact so long as the screen is not treated in any way and the separate colour patches lie next to one another it acts on the eye according to the principle of additive colour mixture, but this viewing screen is turned into one which acts according to the principle of subtractive colour mixture by getting rid of the colours in part and causing those left to run into one another or mix. The getting rid of the colours may be effected by dissolving them out, by bleaching them away by the action of light, or in one modification of the process simply by covering them by a white or tinted deposit or pigment. The mixing of the colours may be effected by chemicals which cause them to transfuse into one another, or by the action of heat or mechanical pressure or both on the films forming the vehicle of the colours. It is this process of changing a colour screen acting on the additive colour-mixture principle into one which acts according to the subtractive colour-mixing principle which forms one of the chief features of the invention.

The actual process of making a colour photograph is as follows:—

Using the taking colour screen, a negative is made on a separate panchromatic plate in the ordinary way. The taking screen is not required any further, and can be used again for other photographs.

A viewing colour screen is now taken, consisting, say, of a film of soft gelatine or any other suitable colloid, impregnated with the coloured dots or lines, and sensitised with any suitable medium, such as potassium bichromate. This is exposed through the negative, taking care that it registers in such a way that the lines or dots of the negative corresponding to the red lines or dots of the taking colour screen are superimposed on the *minus* red (i.e., greenish blue) lines or dots of the viewing screen. Similarly the lines or dots of the negative corresponding to the green and blue-violet lines or dots of the taking screen must respectively register with the *minus* green (i.e., magenta) and *minus* blue (i.e. yellow) lines or dots of the viewing screen. The viewing screen is now treated in exactly the same way as if it were an ordinary carbon print, that is to say, it is transferred on to a support which may be temporary or final, and is developed in water. This will dissolve out the screen entirely in the white portion of the picture, all the colours will be left in the black portion of the picture, the yellow lines or dots consisting of red *plus* green, and the magenta lines or dots consisting of red *plus* blue will be left in the red portion of the picture. The screen is now acted upon with any chemical, such as a solution of ammonia, which will act on the gelatine and cause the neighbouring colour dots to run into one another, or mix, thereby producing the desired subtractive colour effects. The white parts of the picture will have been left free from all colour, the black parts will now appear black or very dark just in the same way as when the three *minus* colours are superposed in ordinary three-colour printing, the red parts of the picture will appear red because the yellow (red *plus* green) lines or dots and the magenta (red *plus* blue) lines or dots have run into one another, and now chiefly transmit or reflect the common component red. Finally, we may if desired retransfer the screen on to a final support. To secure better gradation of colours this final support may take the form of an ordinary black and white or monochrome positive, on to which the screen is transferred in register.—Eng. Pat. No. 22,938, 1913. "B.J.," Nov. 6, 1914, p. 825.

J. and E. Rheinberg have patented a modification of the process of producing multi-colour pictures described above. Experiments have shown that a very slight spread of the colours of the lines or dots into the neighbouring elements suffices to secure an approximation to correct colour rendering in the picture, and that the slight amount of transfusion which inevitably occurs as a result of the process of removal of the colours is in itself sufficient to yield a multicolour picture which may be considered sufficiently good for some purposes. Such pictures are improved by a more complete transfusion of the colours, but so long as transfusion, however slight, occurs, a passable colour picture is obtained.—Eng. Pat. No. 22,764, 1914. "B.J.," April 23, 1915, p. 275

Three-Colour Prints from Screen-Plate Negatives.—J. H. Christensen has patented further improvements in the preparation of three-colour prints from screen-plate negatives. Three pieces of paper or film are coloured with dyes which are for instance complementary to the coloured elements of the screen-plate, and are coated as indicated in a previous patent. These papers are one at a time brought into contact with a single plate or film containing a solution of developer, and illuminated through the coloured negative by light which in each separate case is complementary to the colour of the coloured paper. During the exposure, the developer will act upon the sensitive film, and dye will diffuse into the plate containing the developer in accordance with the intensity of the illumination. After all three coloured papers have been in contact with the developer plate and yielded dye to the same, a picture in the natural colours of the object will then be obtained, which can either be mounted on paper, in which case a paper print is obtained, or be used as a positive transparency. When the screen-plate negative and the developer plate are kept in firm connection with each other, no registering of the coloured papers is required.

The three coloured papers can be produced by coating paper with coloured solutions of a colloid, or they can be produced by soaking (for instance) gelatinised paper in dye solution.

Paper is preferably used in which the dye solutions do not penetrate too deeply into the fibres; for instance, baryta paper. Ordinary white photographic "bromide paper" coloured by soaking can be used.

The dyes used are Echtgrün extra blaulich (Beyer) Echtsäure, Fuchsin G. (Höchst) and pmatype yellow (Höchst), with addition of some formaline. Particulars are given in the Patent Specification of the preparation of these papers.

The printing proper is now effected by placing colour negative, the developer plate containing the developer, and the above-named picture film of porous nitrocellulose in a printing frame in the order named. These are kept in firm connection with each other by suitable clamps, in order not to wet the negative, which is preferably varnished, or a celluloid film may separate it from the developer plate. Then the yellow paper is placed with the film side against the picture film, the printing frame is closed and exposed to blue light through the colour negative, for instance, by means of a suitable blue light-filter. In the course of some minutes the yellow dye is diffused into the picture-film in the places where the blue light passes through the colour negative. The yellow paper is now removed and the same process is then effected with the red paper, which is illuminated with green light, and finally with the green paper, which is illuminated with red light. When these three operations are finished, the picture film which now contains the picture is placed in a solution of copper salt, to which is added a little acetic acid. Thereby the picture becomes clearer and the stability to light, which is initially great, is increased, and the developer solution is at the same time washed out. Mordants other than copper salts may, of course, also be used, and the dye used may be

replaced by others, or modified by adding other dyes Eng Pat No. 13,260, 1914. "B J.," Feb. 5, 1915, p. 90.

Colour Prints from Screen Plate Transparencies J F Phointon has patented the use of paper coated with a layer of fine dots or lines of sensitised coloured gelatine in any desired number of colours for the production of prints from screen plate *negatives* such as those on the Autochrome plate. The various colours forming the coating are embodied with gelatine emulsion, or with plain gelatine, which is then rendered sensitive by means of a bath of bichromate Eng Pat No 13 711, 1914 "B J.," July 16, 1915 p 467

KEY TO THE ABBREVIATIONS OF JOURNALS QUOTED IN "EPITOME OF PROGRESS," WITH ADDRESSES

[We publish this list of journals as in previous years, for the reason that it is practically a complete directory of the photographic journals throughout the world. But it should be mentioned that during the past twelve months no French, German or Austrian photographic publications have reached us with the exception of the 'Photo Revue,' which is now published monthly. I do B J A.]

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|-------------------|----|----|--|
| "A. P." | .. | .. | "The Amateur Photographer and Photographic News" |
| | | | Hazell, Watson & Viner, Ltd, 52, Long Acre London, W.C. |
| "Amer. Phot." | .. | .. | "American Photography" |
| | | | 221, Columbus Avenue, Boston, Mass., U.S.A. |
| "Apollo" | .. | .. | "Apollo" |
| | | | Albrechtstrasse 39b, Dresden A 10, Germany |
| "Atelier" | .. | .. | "Das Atelier" |
| | | | W Knapp, Halle a/Saale, Germany |
| "Aust Phot Journ" | .. | .. | "Harringtons' Photographic Journal" |
| | | | Harringtons, Ltd, 380, George Street, Sydney Australia |
| "Aust Phot Rev" | .. | .. | "Australasian Photo Review" |
| | | | Kodak (Australasia), Ltd, 379, George Street, Sydney, Australia |
| "B. J." | .. | .. | "The British Journal of Photography" |
| | | | Henry Greenwood & Co, Ltd, 24, Wellington Street, Strand London W.C. |

- "B.J.A." "The British Journal Photographic Almanac."
Henry Greenwood & Co., Ltd., 24, Wellington Street, Strand, London, W.C.
- "Bild" "Das Bild."
Neue Photographische Gesellschaft, 27, Siemensstrasse, Berlin-Steglitz.
- "Bull. Belge" "Bulletin de l'Association Belge de Photographie."
Ch. Puttemans, Palais du Midi, Brussels.
- "Bull. Soc. Fr. Phot." "Bulletin de la Société Française de Photographie."
Gauthier-Villars, Quai des Grands-Augustins, 55, Paris, France.
- "Bull. Phot." "Bulletin of Photography."
210-212, North 13th Street, Philadelphia, U.S.A.
- "Cam." "The Camera."
210-212, North 13th Street, Philadelphia, U.S.A.
- "Cam. Craft" "Camera Craft."
413/415, Call Building, San Francisco, Cal., U.S.A.; and 3, Wine Office Court, Fleet Street, London, England.
- "Cam. Work" "Camera Work."
Alfred Stieglitz, 1111, Madison Avenue, New York, U.S.A.
- "Chem. News" "The Chemical News."
E. J. Davey, 16, Newcaste Street, Farringdon Street, London, E.C.
- "Chem. Zeit." "Chemiker Zeitung."
Dr. G. Krause, Cothen (Anhalt), Germany.
- "D. Phot. Zeit" "Deutsche Photographen-Zeitung."
K. Schwier, Sophien Strasse 4, Weimar, Germany.
- "Der Amateur" "Der Amateur."
Mondscheingasse 6, Vienna VII, Austria.
- "Der Phot." "Der Photograph."
L. Fernbach, Bunzlau.
- "Eder's Jahrbuch" "Jahrbuch für Photographie und Reproduktionstechnik."
W. Knapp, Halle a/S., Germany.
- "Il Prog. Foto." "Il Progresso Fotografico."
R. Namias, 36, Via Sestembrini, Milan, Italy.
- "Journ. Phot. Soc. Ind." "Journal of the Photographic Society of India."
40, Chowringhee, Calcutta, India.
- "Journ. Roy. Micr. Soc." "Journal of the Royal Microscopical Society."
Williams & Norgate, 14, Henrietta Street, London, W.C.
- "Journ. S. C. I." "Journal of the Society of Chemical Industry."
Vacher & Sons, Ltd., Westminster House, Great Smith Street, London, S.W.

- "Journ. Soc. Arts" .. "Journal of the Royal Society of Art"
G. Bell & Sons, Ltd., York House, Portugal
Street, London, W.C.
- "Knowledge" "Knowledge."
Knowledge Publishing Co., Ltd., 42, Blooms-
bury Square, London, W.C.
- "Le Phot." "Le Photo Journal."
22, Rue Vurenn, Paris.
- "Mon. Phot." "Le Moniteur de la Photographie."
17, Rue des Moines, Paris, France.
- "Nature" "Nature."
Macmillan & Co., Ltd., St. Martin's Street,
London, W.C.
- "Oest. Phot. Zeit." .. "Oesterreichische Photographen Zeitung."
Oesterreicher Photographen-Verein, Vienna
III/I.
- "Opt." "The Optician."
Gutenberg Press, Ltd., 123, 124 & 125, Fleet
Street, London, E.C.
- "P. M." "The Photo-Miniature."
103, Park Avenue, New York, U.S.A.
- "Pharm. Journ." .. "The Pharmaceutical Journal."
72, Great Russell Street, London, W.C.
- "Phil. Mag." "The Philosophical Magazine."
Taylor & Francis, 7 $\frac{1}{2}$, Red Lion Court, Fleet
Street, London, E.C.
- "Phil. Trans." .. "Philosophical Transactions of the Royal
Society."
Harrison & Sons, 45, St. Martin's Lane, London,
W.C.
- "Phot." "Photography and Focus."
Hiffe & Sons, Ltd., 20, Tudor Street, London,
E.C.
- "Phot. Chron." .. "Photographische Chronik."
W. Knapp, Halle a/Saale, Germany.
- "Phot. Couleurs" .. "La Photographie des Couleurs."
118, Rue d'Assas, Paris.
- "Phot. Indus." .. "Photographische Industrie."
31, Blücherstr., Berlin S 61, Germany.
- "Phot. Journ." .. "Journal of the Royal Photographic Society
of Great Britain" ("The Photo-
graphic Journal").
Harrison & Sons, 45, Pall Mall, London, S.W.
- "Phot. Korr." .. "Photographische Korrespondenz."
Bäckerstrasse 6, Vienna I, Austria.
- "Phot. Kunst" .. "Photographische Kunst."
Paul Heysestrasse 29/31, Munich, Germany.

- "Phot. Journ. America." .. "Photographic Journal of America."
 (formerly "Wilson's Photographic Magazine").
 122, East 25th Street, New York, U.S.A.
- "Phot. Rund." .. "Photographische Rundschau."
 19, Mühlweg, Halle a/S. Germany.
- "Phot. Scraps" .. "Photographic Scraps."
 (discontinued January 1915).
- "Phot. Times" .. "The Photographic Times."
 135, West Fourteenth Street, New York, U.S.A.
- "Phot. Welt" .. "Photographische Welt."
 (M. Eger), 4, Gabelsbergerstrasse, Leipzig, Germany.
- "Phot. Woch." .. "Photographisches Wochenblatt."
 13A, Genthiner Strasse, Berlin W.
- "Photo-Era" .. "Photo-Era."
 383, Boylston Street, Boston, Mass., U.S.A.
- "Photo Gazette" .. "Le Photo Gazette."
 1, Rue de Médecins, Paris, France.
- "Photo-Revue" .. "Photo-Revue."
 118, Rue d'Assas, Paris VI, France.
- "Photo-Woche" .. "Photo-Woche."
 6, Lietzensoer Ufer, Charlottenburg, Berlin.
- "Photographie" .. "La Photographie."
 118, Rue d'Assas, Paris, France.
- "Phys. Rev." .. "The Physical Review."
 41, North Queen Street, Lancaster, Pa., U.S.A.
- "Procédé" .. "Le Procédé."
 150, Boulevard de Montparnasse, Paris XIV.
- "Rev. Trimest." .. "Revue des Travaux de Recherches."
 A. Lumière et ses Fils, Lyons.
- "Sci. Amer." .. "The Scientific American."
 Munn & Co., Inc., 361, Broadway, New York, U.S.A.
- "Sonne" .. "Sonne."
 Kaiser-Platz, 18, Wilmersdorf, Berlin.
- "Wiener F. Phot. Zeit." .. "Wiener Freie Photographen Zeitung."
 Gustav Walter, Alserstrasse 71, Vienna VIII, Austria.
- "Wien. Mitt." .. "Wiener Mitteilungen."
 Graben 31, Vienna I, Austria.
- "Wilson's" .. "Wilson's Photographic Magazine," now
 "Photographic Journal of America."
 122, East 25th Street, New York, U.S.A.
- "Zeit. für Instr." .. "Zeitschrift für Instrumentenkunde."
 Julius Springer, Berlin.
- "Zeit. für Repro." .. "Zeitschrift für Reproduktionstechnik."
 W. Knapp, Halle a/Saale, Germany.
- "Zeit. für Wiss. Phot." .. "Zeitschrift für Wissenschaftliche Photographie."
 J. A. Barth, 16, Dürrienstrasse, Leipzig, Germany.

BRITISH RESOURCES IN THE MANUFACTURE OF PHOTO- GRAPHIC MATERIALS AND APPARATUS.

BY THE EDITOR

Usually in the *Almanac* we devote a considerable number of pages each year to a review of new introductions in the way of apparatus (conditions at the opening of the second year of the European war are such as to lead us to suspend that feature and to replace it by another more adequately serving the interests of the British photographic industry). The times have not been propitious for new goods. Buyers have many of them had other interests, and makers have had enough to do in dealing with technical difficulties or in carrying out Government contracts.

Therefore the occasion has seemed to us a fitting one on which to pass in review the resources of the United Kingdom in the supply of the photographic requisites in chief demand. This *Almanac* comes into the hands of buyers large and small in all parts of the globe and our review, we hope, will be of service to them by showing what Great Britain can do in the various branches of photographic manufacture. In that respect we have included also the productions of certain well-known firms of Foreign nationality as well as those of the two American companies whose goods are preeminently upon the market in this country.

It is hardly necessary to explain that in the pages which follow we are unable to refer to each and every article or even to every individual manufacturer connected with the photographic trade. We have had to take a broad view and it is as such that this war time feature of the present *Almanac* is offered, in the aspiration that when peace is at length restored all sections of the photographic trading community in this country may benefit by the emphasis which we have laid on the productive resources of this country.

PLATES, FILM, AND PAPERS.

Autotype Co.—As the first manufacturers of materials for carbon printing under the patent of the late Sir J. W. Swan, the Autotype Company have naturally taken the leading position in connection with the process and have consistently maintained it by the high standard of their manufactures. At the present time they make tissue in nearly forty different colours, in itself a technical achievement, since the Company have invariably made it a principle to use for their tissues only pigments of unimpeachable permanence. The series of transfer papers likewise runs into a considerable list, embracing papers thick and thin and of rough or smooth surface suitable for large and small work. The colour charts, consisting of a series of finished prints prepared by means of various tissues and transfer papers, show the exceedingly fine range of effects obtained with the Autotype materials. Carbon, it may be remarked, has experienced something of a revival of late among the better class of professional photographers owing to the increases in the cost of chemicals and as a consequence of the greater or less disturbance which has inevitably been caused in the manufacture of silver printing-papers as the result of the war. The carbon printer, requiring only bichromate and album, has been fortunately almost entirely free from the vagaries of the chemical market.

We should also refer to a quite recent Autotype introduction, namely, white tissue for printing by the carbon process from a positive. The effects produced are unlike those by any photographic method, the shadows of the subject being formed by the dark support to which the developed print is transferred. The process allows of some exceedingly pleasing and novel effects in portraiture, and has industrial applications such as the making of labels on wood or other surface in which the natural texture of the material is retained.

It should be added that a more recent special branch of the Autotype Company's business has been the manufacture of tissues specially for rotary photogravure. Their tissues for this process have been used by almost every house of note in this country and America. The "G5" tissue is perhaps the most generally employed owing to the delicate character of the resist obtained with it through which the process of etching can be easily watched. Another tissue, "Diapositive" No. 171, is also used largely for the making of positive transparencies used in rotary photogravure, its matt surface on the glass allowing of ample retouching being done without the use of a medium. Rotogravure is still a process in which there is much to be learned, and therefore it may be of interest to say that the Autotype Company are always glad to give their advice and assistance to customers encountering difficulties. Address: 74, New Oxford Street, London, W.C.

Baryta, Ltd.—In several respects special notice is deservedly claimed by this comparative new comer among manufacturers of photographic materials. In the first place, Messrs. Baryta, Ltd.,

BRITISH RESOURCES.—PLATES, FILM, AND PAPERS—continued.

are manufacturers of photographic papers from start to finish, that is to say they "baryta-coat" the raw paper, not only for bromide and gaslight emulsions but also for print out gelatine and collodion emulsions, which latter, as is well known, call for the highest degree of the baryta-coater's skill and experience. In their newly-erected factory at Watford, Herts, they are able to carry out this important and delicate baryta coating upon a very large scale.

They are also themselves manufacturers and coaters of the finished emulsion papers, and in this branch of their business have the advantage of co-ordination between the process of baryta coating and that of making and applying the sensitive emulsion. It is again a well-known fact that baryta coating requires to be done particularly with regard to the character of the sensitive emulsion which the paper is to bear, and, therefore, a firm which conducts both branches of manufacture under one roof is obviously particularly well equipped for ensuring the high quality of its finished products. Messrs. Baryta, Ltd., are manufacturing bromide papers in the customary series of surfaces, and are also issuing a series of gaslight papers, some of which are of quite special character. Their standard grade of gaslight is "Sunlox," a paper of somewhat greater sensitiveness than the average stock gaslight paper, and of remarkable quality as regards gradation, non-liability to stain and stress markings, and in its hardened emulsion, the latter resisting practically any conditions of heat which are liable to occur in manipulation. "Sunlox" is made in both soft and vigorous grades. Another series of gaslight papers are those specially made for professional use, about the same speed as "Sunlox" but somewhat softer in gradation, yielding prints of warm black colour and readily amenable to the production of warm-tone prints by greater exposure and restrained development. A special feature of the papers is their immunity to the customary bad effect of bromide upon the colour of the prints. Still another series of gaslight papers are those to be issued for specially high grade prints. The paper is appreciably slower than "Sunlox," but considerably more rapid than papers yielding similar results. Like the other varieties of gaslight paper, it is guaranteed by the makers against staining and frilling or blistering under any conditions.

Two distinct novelties in printing papers are also being issued, one a self-developing gaslight paper. The developer for this is simply an alkaline bath. The paper is much slower than "Sunlox," and yields more contrast than the latter. It is intended specially for use from amateurs' negatives. The second novelty is a paper which can be used either as P.O.P. or gaslight. As gaslight it yields a fairly contrastive print, whilst as P.O.P. it tones excellently in a weak gold bath. Lastly, we must mention a special P.O.P. free from silver, and therefore guaranteed to retain its original quality for years. This paper has the special features of quick printing, quick toning, and the use of very little gold for the latter operation. We have had an opportunity of trying some of the papers referred to above, and of examining specimen prints made

BRITISH RESOURCES.—PLATES, FILM, AND PAPERS—*continued.*

upon all of them. We shall take the occasion to refer to them at greater length in due course in the "British Journal." Address: Cassio Bridge, Watford, Herts.

Criterion, Ltd.—This Midland firm, with its factory in the country upon the outskirts of Birmingham, was for a considerable number of years a maker of papers and postcards only, although of late it has added plates and cinematograph film to its manufactures. In papers it has been a pioneer in the manufacture of bromide and gaslight papers of the glossy and semi-glossy descriptions with non-liability to the unsightly stress markings which were long an annoying defect of emulsion papers possessing any distinct sheen. The Criterion "Non-Stress" bromide and gaslight papers are, as we have on many occasions proved to our own satisfaction, to all intents and purposes free from this defect. The production of stress marks is, of course, to a large extent a matter of more or less careless manipulation, but in circumstances specially conditioned to favour the production of these disfiguring lines and markings we have invariably failed to get them on the Criterion papers. The company was also a pioneer in issuing its gaslight paper, "Celerio," in a form in which it would yield first-class sepia tones by the sulphide method. This was at a time when gaslight papers generally did not work well by the sulphide method. Criterion P.O.P. and the self-toning P.O.P., made with both a collodion and gelatine-emulsion, are also highly distinctive products, the ordinary P.O.P. being an exceedingly fine grade of this description of paper, yielding extremely brilliant prints and exhibiting great economy as regards the consumption of gold required for toning. The dry-plates represented by a range of speeds from those of ultra rapidity to the slow plate for photo-mechanical work, and including isochromatic plates of medium and extra-rapid sensitiveness. Cinematograph film is made for both negative and positive work. Address: Stechford, Birmingham.

Edwards, Austin, Ltd.—The manufacture of roll-film for photographic and cinematograph use is the sole and special business of Messrs. Austin Edwards, Ltd., whose product for photographic cameras is marketed through Messrs. Houghtons, under the trade-mark "Ensign," and has deservedly attained a very wide degree of popularity for its speed and general and orthochromatic quality. Ensign film is supplied in spools ranging in width from $1\frac{1}{2}$ ins. to 7 ins., the series including ten different widths and representing altogether seventeen different types of spool, covering practically every film-camera upon the market. In the cinematographic field the firm manufacture film for both negative and positive work and is a printer of cinematograph film for the trade. Address: Warwick, England.

Elliott and Sons, Ltd.—The pleasant Hertfordshire town of Barnet, in the pure air of the country, but within half an hour of

BRITISH RESOURCES.—PLATES, FILM, AND PAPERS—continued.

the centre of London, has provided Messrs. Elliott with a name under which their manufactures are perhaps more widely known than under that of the makers themselves. Barnet plates and papers have long maintained a high reputation for quality and distinctiveness since the establishment of the business thirty years ago. In plates the Barnet series covers the full range of these materials, ultra speed being represented by the "Red Seal" plate. The Barnet "Red Diamond" is a slightly slower plate, but, nevertheless, of high speed, whilst Messrs. Elliott manufacture several plates specially for portraiture. A recent introduction of theirs is their "Special Rapid," a plate of 225 H. and D. which embodies the results of recent considerable research work by which the makers have been able to manufacture batch after batch with a degree of uniformity not hitherto achieved. This new plate is of rapidity suitable for studio work and snapshot exposures, and will doubtless enhance the makers' reputation on the ground also of its working qualities.

In process and lantern-plates Messrs. Elliott have their distinctive productions, the Barnet lantern plates, one of the rapid kind for cold tones and a slower plate for warm tones, being great favourites with lantern-slide makers. We should also specially signalise the firm's "X-Ray" plates, introduced since the outbreak of war, and already largely used at home and abroad. A further special Barnet plate is the "Stella," prepared for astronomical photography.

The Barnet plates also include a series of orthochromatic emulsions, one of which, the "Ortho Super-Speed," is an ultra-rapid orthochromatic plate, whilst the "Ortho Self-Screen" is of the class yielding a considerable degree of orthochromatic correction without the use of the light-filter.

Bromide, gaslight, and P.O.P. papers are likewise Barnet productions which have attained wide popularity. The bromide papers, whilst covering the customary range of surfaces, include several of distinctive quality, such as the "Tiger Tongue" and the "Velbro." The former is of extra rough surface, a paper of water-colour grade being used; the latter is of velvet or carbon surface of an exceedingly fine kind, and in great favour for professional contact prints, as well as for enlargements. The gaslight papers are made in the vigorous and soft grades, also in a series of surfaces, matt, semi-glossy, and glossy, whilst a special grade is the "Oyster-Shell," a name which well suggests the pearly delicacy of the surface. Throughout the period of the war Messrs. Elliott have been able still to manufacture their standard bromide papers upon the Rives base, thus obtaining, although at a heavy cost, the quality and uniformity for which their goods are noted.

We should also mention a further specialty of the firm—namely, the manufacture of postcards in bulk quantity, a fact which will no doubt be noted by buyers in markets now cut off from German supplies.

BRITISH RESOURCES. - PLATES, FILM, AND PAPERS—*continued.*

Messrs. Elliott are also one of the few makers of carbon tissues and transfer papers in a great variety of colours and surfaces respectively, a branch of their business in which they have the advantage of the experience of a special department devoted to the making of carbon prints and enlargements for the trade. Address: Barnet, Herts.

Gem Dry Plate Co., Ltd.—Though chiefly known for its manufacture of plates, the Gem Company is also a maker of printing-papers, bromide, gaslight, and self-toning, the latter a gelatine paper. In plates its productions range over the whole field, and include ordinary plates, both rapid and slow, orthochromatic and panchromatic plates, process plates, and lantern plates, as well as a plate for X-ray work. Among this great variety we may perhaps signalise the Gem "Gold Label," a plate of ultra speed and quality, coated upon specially selected glass. In the X-ray plates exceptional sensitiveness to the Röntgen rays is secured, whilst the plates are packed in one or other of three forms according to customers' requirements. They may be obtained packed in the ordinary way, or enclosed singly in double wrappers or in double envelopes, the two latter forms of packing permitting of a dark-room being dispensed with until the plates come to be developed. Another specialty of the firm is a stripping plate, manufactured for ready removal of the film from its glass support for use in flexible form or for transference to another support, when, for example, a reversed negative is required. This stripping plate is supplied with either the process or lantern emulsion. Address: Cricklewood, London, N.W.

Griffin, John J., and Sons, Ltd.—As manufacturers of printing papers Messrs. Griffin are perhaps chiefly notable for their paper of the gaslight class, "Noctona," which in one respect particularly is a distinctive product, since "Noctona" allows of considerable variation in the contrast of the print by adjustment of exposure and development. Soft results are obtained by short exposure and full development; those of greater vigour, by longer exposure and brief development. Thus "Noctona" is made only in one grade as regards contrast, but in a number of varieties—glossy, satin, and pearl-matt—as regards surface. Among other papers of Messrs. Griffin's is their self-toning "Goldona," yielding a wide range of tones by fixation in hypo only, and their series of bromide papers, among which is one specially made for use in the Bromoil process. They have also their own brand of P.O.P., likewise made in a variety of surfaces. Address: Kemble Street, Kingsway, London, W.C.

Halden, J., and Co., Ltd.—Although not engaged in what is generally regarded as the photo-materials trade, mention may appropriately be made here of Messrs. Halden's manufacture upon the large scale of the sensitive papers used in quantities by engi-

BRITISH RESOURCES.—PLATES, FILM, AND PAPERS—continued.

neering firms for the copying of plans and patents. These include the customary iron papers serving for the production of copies in white lines on a blue ground as well as those yielding duplicates in blue-black or black lines upon a white ground. Messrs. Halden are also makers of a number of patterns of printing machines serving for the exposure of the largest and smallest tracings by artificial light. Address: 8, Albert Square, Manchester.

Ilford, Ltd.—There is good reason why the products of the Ilford Company have penetrated to every part of the world, yet probably many present-day users of Ilford plates or papers are unacquainted with the two revolutions wrought by the Ilford Company in photographic practice, first the establishment of the dry-plate process on a lasting basis by their introduction of plates at popular prices, and second their introduction of printing-out paper (the contraction P.O.P. had its origin in the Ilford factory), by which albumenised paper was quickly swept from its universal field, and the way paved for the introduction of other descriptions of gelatine-emulsion paper. But whilst the Ilford Company spread its business in all countries by this pioneering enterprise, it has jealously safeguarded its reputation by a permanent policy of maintaining the highest quality in its manufactures. At times, perhaps, in the past, it has not been among the first to issue a new description of photographic material, but it has invariably justified any conservative instincts by the perfection to which it has brought each successive new product before placing it upon the market. At the present time its manufactures cover the whole range of photographic materials. As regards plates individual tastes vary, but those of the Ilford brand enjoy a reputation second to none. The Ilford "Ordinary," which was thought fast in the early days of dry plate photography, has been altogether outclassed by plates such as the "Zenith" and "Monarch," the latter on its introduction marking a notable step in advance in its combination of extreme speed, quality, and fineness of grain. The Ilford orthochromatic plates include the medium speed "Chromatic" and the more sensitive "Rapid Chromatic" and "Screen Chromatic," whilst in addition there is the Ilford "Panchromatic." Plates specially for photo-engraving and for X-ray work have also long been a specialty of the Ilford Company, whilst the lantern-slide worker is catered for by a bromide plate suitable for black and warm-tone slides, as well as by the "Alpha" lantern-plate, the latter a unique material for contact slide making and giving a wide range of tones, red, brown, sepia, purple, and blue, of remarkable brilliance and transparency.

As regards printing papers, Messrs. Ilford, Ltd., are associated with distinctively fine manufactures. Their P.O.P., for many years the standard of this description of paper, is still made in the glossy, carbon-surface, and matt varieties and has recently been supplemented by a tropical grade, with hardened gelatine film for use in the most trying climates. Ilford bromide papers cover a range of surfaces and tints which provides almost every step from a high

BRITISH RESOURCES.—PLATES, FILM, AND PAPERS—*continued.*

gloss to a canvas effect. In particular the smooth and rough grades, in white and cream, of their platino-matt bromide papers exhibit a natural surface which has rendered them highly popular. The "Bromona" papers are of the rapid class with the distinctive feature of being coated on a base of cream, grey, sea-green, or aquamarine colour, each in conjunction with a surface texture of pleasing roughness. These papers are unique in the effects they permit in enlargement work. Ilford gaslight papers are made in three grades for use with average, contrasty, or flat negatives, whilst among self-toning papers the firm is represented by "Intona" a paper yielding a wide range of tones without a salt or extra bath, that is, with hypo only, and by "Hyptona," a self-toning paper of collodion emulsion. Lastly may be mentioned the firm's collodion P.O.P. for toning with gold or platinum, or by the customary process of first one and then the other. It should be added that the Company is one which has constantly lent its assistance to users of its goods by the issue of technical booklets dealing with methods and formula, and with the difficulties most commonly encountered by the inexperienced. Address: Ilford, London, E.

Illingworth, Thomas, and Co., Ltd.—Messrs. Illingworth occupy a distinctive place among photographic firms from the fact that they are manufacturers only of materials for printing processes. They do not make plates, but their production of bromide and gaslight papers and postcards is upon a very large scale, and is conducted in one of the most modern factories established some two years ago as a necessity of the firm's expansion. In normal conditions they are also makers of P.O.P. and self-toning paper, although at the time of preparing these notes that branch of manufacture is temporarily suspended as the result of disturbances in the supply of raw stock. The bulk, however, of Messrs. Illingworth's business, we should judge, is in bromide and gaslight papers, of which they make a very full range of grades and surfaces. As regards the bromide paper, the varieties include the customary rough and matt surfaces specially made with a view to the working-up and colouring of enlargements and other large prints. The "Ivory Matt" is a dead matt specially suitable for small work and adapted for working-up and for artists' work with a knife. The Illingworth "Zelvo" is a paper of velvet-like surface—that is to say, with the slight sheen well suited for small prints and for half-tone reproduction. The glossy paper is made of slight mauve tint, which, with hypo-alum toning, yields a colour closely resembling a good P.O.P., whilst specially for the purposes of the Press photographer a glossy paper of extra contrast is made with non-liability to stress marks.

The above series of bromide papers has more recently been supplemented by an extra quality of paper, "Bromide de Luxe," yielding exceedingly fine gradation and affording prints of strikingly "rich" character. This paper is made in four grades—white-smooth, white-rough, cream-smooth, and cream-rough—each

BRITISH RESOURCES - PLATES, FILM, AND PAPERS—continued

in single and double weight. In addition, Messrs. Illingworth make a paper of thick substance and semi matt surface specially for the Bromoil process as also "Ozobrome Bromide," a paper of an extra stout surface capable of withstanding the necessary wear and tear in making a number of carbon prints from one bromide by the Ozobrome method.

The Illingworth gaslight paper, 'Slogas,' is made in three surfaces—glossy, matt, and satin—and two grades—Portrait, for negatives of average vigour and Vigorous, for use with soft weak, or thin negatives.

Mention should also be made of the firm's manufacture of carbon tissues and transfer paper for the regular carbon process and for rotary photography as also the special 'pigment plasters' and transfer papers for the Ozobrome process for all the materials of which Messrs. Illingworth are the sole selling agents. Address, Park Royal, Willesden Junction, London N.W.

Imperial Dry Plate Co. Ltd. While some manufacturers are more particularly known by their papers and others for both plates and papers, the Imperial Company is and always has been emphatically a plate firm in which branch of manufacture its position has been universally recognised as pre-eminent. Imperial plates have commanded and continue to command enormous sales not in Great Britain only or even throughout the British possessions but also in foreign countries where they have had to compete against a protective tariff. England is, as well known, the birthplace of the gelatine dry plate. Knowledge and experience in the making of dry plate emulsions were disseminated in the early days of the process largely by the publication of papers by English experimenters in the English photographic periodicals and thus it is no more than fitting that photographic dry plates of British manufacture should continue to command the markets in almost all parts of the world vigorously though their position has been assailed by makers in other countries. For the maintenance of that position no firm has been more largely responsible than the Imperial Dry Plate Company, as the outcome first, of the distinctive quality of their products and, secondly, of the remarkable uniformity of the plates from one year's end to another. Without exaggeration, it can be said that the Imperial "Special Rapid" and "Special Sensitive"—particularly the former—have become standards among dry plates. But the company is equally well known among both professional and amateur users by its plate of ultra speed the Imperial "Flashlight," a plate which in addition to extreme sensitiveness allows of development being "forced" to a degree which is remarkable in an emulsion of its great speed. As scientific research has shown the H and D number of a plate, even when determined with meticulous accuracy, is far from being a complete indication of the kind of negative which can be made with an extremely brief exposure.

BRITISH RESOURCES—PLATES, FILM, AND PAPERS—*continued*

Other qualities of the emulsion intervene, and in this respect—of general all round quality—the Imperial “Flashlight” has attained a justifiably great reputation.

Orthochromatic plates are made in two speeds, approximately corresponding with those of the Imperial “S R” and “S S” plates. In addition to which the Imperial Company make an “N F” (non filter) orthochromatic plate of such sensitiveness to yellow and green that a considerable degree of orthochromatic correction is obtained without the use of a light filter, the speed of the plates at the same time sufficing for hand camera work. Mention should also be made of the slower speeds of Imperial plate for copying and slow landscape work and for process purposes. Lantern plates are made in two grades—one of the normal lantern rapidity for slides of black or slightly warm black tone, and the other of gaslight speed for tones ranging from brown or sepia to red.

As regards papers or postcards, the Imperial Company are makers of bromide gaslight, self toning, and P O P, each in a series of tints and surfaces covering the customary requirements. The bromide and gaslight papers are made as rough matt semi matt, and gloss, whilst P O P and self toning, are manufactured in glossy and matt.

Mention should also be made of the ‘Imperial Handbook’ issued gratuitously each year by the company chiefly by way of supplying technical advice and information to amateur workers. Address: Cricklewood London N W.

Kentmere, Ltd—Papers and postcards with P O P gaslight and bromide emulsions are the manufactures of this firm, its speciality being bromide and issued a ‘K K’ for use with rotary machine printers and for automatic development and toning. The “K K” is a somewhat slow bromide but one yielding good contrast even with indifferent negatives. Another special feature of it is its extreme amenability to toning. Messrs Kentmere supply a special sepia toner to form a working bath by simple addition of water, the solution then yielding a fine sepia on the “K K” rolls or sheets within a few minutes and without the necessity of previous washing from hypo beyond the briefest rinse. The regular (more rapid) bromide paper gaslight and P O P are manufactured in a wide range of surfaces and are supplied in all the customary cut sizes as well as in rolls, strips and singles.

In addition the Kentmere Company act as sole selling agents for the “Yto” self toning papers and cards distinctive printing papers which require only fixation in ordinary hypo and in regard to which the makers confidently put forward claims for exceptional keeping quality. “Yto” it is pointed out is a printing paper which contains no free silver, and will thus keep good and white for years and remain unaffected by cold or heat or other climatic conditions. Five years is stated to be a normal time during which

BRITISH RESOURCES.—PLATES, FILM, AND PAPERS—*continued.*

the paper will fully retain its original quality. Address: Staveley, Westmorland.

Kosmos Photographics, Ltd.—The Kosmos Company is one which specialises solely in the manufacture of bromide and gaslight papers, their goods having quickly achieved a high reputation since their introduction to the British market in 1913. Their "Vitagas" paper is a distinctive production, of speed intermediate between bromide and gaslight, requiring about four times the exposure of the average bromide paper. While the paper is of ample speed for both contact and enlarging work, the results are characterised by exceedingly fine vigour and richness such as is associated with papers of the gaslight class. Moreover, the paper yields prints of pleasing warm black colour, and thus provides an efficient and economical substitute for collodion print-out paper. The Kosmos bromide paper is manufactured in two grades, the ordinary yielding about the average contrast and suitable for the general run of contact and enlarging work, whilst the vigorous is specially adapted for flatter negatives. Another speciality is the glossy variety of the bromide paper, in the manufacture of which special measures are taken to yield a product free from liability to give stress marks in use. Both the bromide and "Vitagas" papers are made in a full range of surfaces in both paper and card thickness, and both are particularly well fitted for yielding rich tones by sulphide toning. Address: Letchworth, Herts.

Leto Photo Materials Co., Ltd.—Seltona (collodion) self-toning paper is perhaps the product by which the Leto Company is most widely known. For many years past "Seltona" has taken a leading place in popular favour among self-toning papers, and has been very largely used not only by amateur workers, to whom self-toning paper chiefly appealed at the outset, but by professional photographers who have appreciated the rich sepia effects obtained on "Seltona" by the simplest manipulation, as well as the fine warm blacks readily secured by platinum toning. "Seltona" is manufactured in a series of surfaces ranging from glossy to rough, as also in several other varieties—e.g., those of linen surface and of tinted base, the latter being issued as cream-crayon, blue, green, and steel-grey. The Leto manufactures likewise include other collodion papers for toning in the customary way, bromide and gaslight, as well as heavier (card thickness) grades of all these papers under the name of "Boardoids." The stouter prints on these papers have been extensively used by professional workers for insertion in folder mounts, the Leto Company supplying a wide range of these covers, and also simple forms of plate-marker by means of which the enhanced effect of a plate-mark impression round a print, made under a mask, is very readily obtained.

Of plates, too, the Leto Company manufacture a wide range of ordinary and isochromatic, their series of the latter class including

BRITISH RESOURCES.—PLATES, FILM, AND PAPERS—*continued*

some of those originally introduced by the firm of B J Edwards and Co., whose business was taken over some years ago by the Leto Company. Among the plates are also the Edwards 'Special Transparency' and 'Kristal' for lantern work, the latter a gaslight plate. Address: Roman Wall House, 1, Crutched Friars, London E.C.

Marion and Co., Ltd.—Messrs Marion were one of the earliest firms to engage in the manufacture of dry plates on the large commercial scale. In fact, that is, for thirty or thirty-five years ago, when hand coating was still the commercial method. Since that time their constantly accumulating experience has enabled them to produce ever better and faster plates of all descriptions, from those of the slow landscape variety to those of ultra speed. In the matter of speed combined with remarkably fine quality Messrs Marion may be fairly said to have established a record in their latest plate appropriately named the 'Record,' and embodying a degree of sensitiveness in conjunction with freedom from fog and a fine range of gradation which we do not believe to have been hitherto attained. Another recent product of their plate factory is the 'Brilliant,' a plate of high speed designed chiefly for portraiture and yielding negatives of extra 'pluck' or contrast such as many portrait photographers have demanded of late, doubtless as the result of the popularity of the sketch style of portrait. Of lantern plates Messrs Marion have long made a specialty, particularly of those with chloro-bromide emulsion yielding rich warm tones.

Their manufactures include also bromide, P.O.P., and collodio-chloride papers, in addition to gaslight, one well known brand of which is their 'Nyte-lite,' a gaslight paper yielding the rich contrast exhibited by papers of this class, but developing in the leisurely manner of a bromide. Their print-out papers include also one of collodio-chloride emulsion a 'gross grain' P.O.P. yielding pleasingly broad effects; a 'Mutt-albumen' paper, giving the soft rich appearance of an engraving and made in eleven different grades as well as a 'Mezzo-Tint' paper, likewise a distinctive production, lending itself to characteristic effects. Address 3, Soho Square, London, W.

Mawson and Swan, Ltd.—Unlike most manufacturers of photographic materials, Messrs Mawson and Swan do not make printing papers, although the late Sir Joseph Swan, the founder of the firm, was a pioneer in the use of bromide emulsion for positive printing. The Mawson plates, however, orthochromatic and ordinary, are distinctive productions, notably so the firm's 'Wizard' plate of extreme rapidity and bearing an emulsion of a special character, largely counteracting the effect of over-exposure and yielding exceedingly crisp definition in circumstances which, with an ordinary plate, would call for the use of a backing. Another Mawson plate the 'Gladiator,' is also of very extreme speed,

BRITISH RESOURCES - PLATES, FILM, AND PAPERS—*continued*

whilst among those of more moderate sensitiveness are the "Felix" and the "Felix Professional," the latter still a fast plate, specially suitable for studio portraiture and outdoor Press photography. The Mawson photo mechanical plate has long been a favourite for photo engraving and copying work, whilst, equally, the Mawson lantern plate has been the choice for many years past of expert slide makers. All the Mawson plates can be obtained with a special thin, transparent soluble backing which disappears entirely within a few seconds of placing the plate in the developer, leaving no insoluble deposit in the latter.

Among photographic materials should also be mentioned the Mawson collodion for the wet plate process, which has long been a standard product particularly among those engaged in photo-mechanical work. Address: Mosley Street, Newcastle on Tyne.

Paget Prize Plate Co. Ltd. The history of the Paget Prize Plate Company goes back to the early days of the commercial manufacture of gelatine emulsion dry plates, when, in common with a few other makers they were pioneers in the investigation of the manufacture of gelatine plates. Their experience in the preparation and coating of gelatine emulsion for negative work has thus been gathered throughout a term of years which must be very little less than that of any firm in the trade. Their list of dry plates now includes the most comprehensive bands, from the slow 'XX' and medium speed 'XXX' to a plate, the "Extra Special Rapid," of extreme speed. They have likewise produced a series of ortho-chromatic plates, one of extreme speed, the "Extra Special Rapid Ortho," and another, the 'SF' of the self screening type. They have also been one of the comparatively few makers to place a pan-chromatic plate upon the market. The series also includes plates specially made for portrait work as well as a slow and fast lantern plate, both of which have obtained a very high degree of popularity among lantern slide makers. Mention should also be made of the introduction, a year or two ago, of the "Hydra" plate, an emulsion of a special character immune from the effects of over exposure, and of special value in dealing with subjects beyond the capacity of the ordinary emulsion.

The name of Paget, however, is equally or even better known in connection with printing papers, the firm being the leading maker of collodion self-toning paper. This despite many difficulties created by the war, they have continued to manufacture without a break and are able to supply in all surfaces, viz. glossy matt, white, rough, cream rough, and cream smooth. Paget self-toning paper has consistently maintained its reputation as a material of the highest quality and one, owing to the nature of the emulsion, specially suited to hot climates. Bromide and P.O.P. are likewise manufactured in a full range of surfaces, whilst the Paget gaslight paper, "Gravura," is a quite distinctive production, the special feature of which is the wide range of warm tones obtainable by modification of exposure and developer. The same emulsion is supplied coated on glass for lantern-slide making.

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Lastly, we should not omit to mention from this notice the Paget process of colour photography by means of a screen-plate, issued for use separately from the panchromatic plate, and thus serving for the production very readily of any required number of colour-transparencies as the result of a single exposure. The Company issue screen plate taking screens and viewing-screens, and many workers have produced exceedingly beautiful colour lantern-slides by the process. Address: Watford, Herts.

Platinotype Co.—It is unquestionably an unnecessary task to refer at length to the unique place occupied by the Platinotype Company as the originators and largest manufacturers of paper for the making of platinum prints. Wherever platinum printing is done the paper—Platinotype—of the Company, is recognised as the hallmark of excellence. It is hardly possible to write too highly in praise of the makers' consistent success in issuing only a product which should conform to the highest standard—a success which is the more notable when the technical difficulties of manufacture are realised. Of late years the original black and sepia Platinotype papers have been supplemented by others, first by those of the "Japine" class, papers of hard, semi glossy surface of most artistic appearance, immune to mechanical damage, and specially adaptable to all kinds of colouring. The "Japine" papers, like the original Platinotype, are issued for black and sepia prints, the former by cold and the latter by hot development. A special feature of the sepia tone, both upon "Japine" and upon ordinary Platinotype, is the proved permanence of the prints.

A still later introduction of the Platinotype Company is a most beautiful printing process issued under the name "Satista." It is a silver-platinum process, and thus the paper can be sold at a price considerably below that of Platinotype. Nevertheless, the results are fully the equal of Platinotype in appearance, and practically its equal in permanence, whilst the manipulation is exactly that in ordinary platinum printing, with the addition of the use of a hypo fixing bath. The greater speed (about three times) is a further attractive feature of "Satista." It should be added that "Satista" is a Japine paper, exhibiting the distinctive qualities already mentioned.

A still further addition to the Company's productions is "Silver Japine," a print-out paper on the Japine base, and yielding a silver image. Although sold at the same price as other P.O.P. papers, "Silver Japine" provides prints of handsome, distinctive appearance. It is a little speedier in printing than P.O.P. and is altogether distinct from gelatine or collodion P.O.P. in the readiness and economy with which it yields fine tones from warm brown to warm black by platinum toning. Good use has already been made of "Silver Japine" by leading professional photographers, and there is no doubt that this new product will rank equally in reputation with the other manufactures of the Platinotype Company. Address: 66, Beckenham Road, Penge.

BRITISH RESOURCES.—PLATES, FILM, AND PAPERS—continued.

Rajar, Ltd.—This North of England firm is, perhaps, most prominent as a manufacturer of printing papers (bromide, gaslight, P.O.P., and self-toning), but it includes also plates and roll-film among its productions. As regards papers the firm is one which is a very large producer of bromide and gaslight card for postcard printing and also specialises in the supply of sensitive material in quantity for customers' individual requirements in, say, enlarging, fine art publishing, box decoration, etc.—to name only a few of the many industrial uses for photographs at the present time. The bromide papers are issued in a very full range of surfaces and tints; the gaslight paper is made in two grades, "ordinary" for contrastive effects, and "special portrait" for soft results, each in various surfaces. A further member of the Rajar series of development papers is "Rajana," a paper of speed intermediate between bromide and gaslight, and yielding prints of rich warm black colour. This again is made, as paper or card, in a series of surfaces from glossy to cream crayon. The printing out paper is issued as "Rajar P.O.P.," the self-toning, as "Autona," the latter a paper yielding excellent copia to purple tones by simple fixation in hypo. For these various papers Messrs. Rajar, Ltd., have recently put in operation their own baryta-coating plant, thus making themselves more completely independent of outside supplies or those from the Continent. They feel some justifiable pride in pointing out that every article used in the manufacture of their goods paper, baryta-coating, gelatine, chemicals, packing papers, etc.—is in every instance of British manufacture. Address: Moberley, Cheshire.

Wellington and Ward.—For some considerable number of years after their establishment Messrs. Wellington and Ward were manufacturers only of printing papers, and, as the outcome of their special devotion to this branch of manufacture, it is not too much to say that Wellington papers (particularly the all-popular bromide and gaslight) have become a universally recognised standard of quality. Within the scope of these notes it is impossible to describe adequately the varieties of even the Wellington bromides only. The paper is made of six kinds—Platino-Matt Ordinary, Carbon, Canvas, Chamois, and Enammo—names which convey, more or less definitely, the description of surface. But each kind is manufactured in a series of grades—for example, the Platino-Matt in nine grades, representing degrees of roughness, colour, and speed. Similarly the Ordinary paper (of delicate sheen) is made as smooth, rough, and cream crayon rough. The Carbon, of semi-matt surface, is made in two grades only, thin and thick; whilst the Canvas paper, of broken surface, resembling a natural fabric, is made as cream and white. The Chamois paper is an exceedingly fine material, having the distinctively smooth delicate surface akin to chamois leather, and particularly adapted for finishing in pencil and water-colour. It is made in four grades, whilst the Enammo (glossy) paper is made in nine

BRITISH RESOURCES.—PLATES, FILM, AND PAPERS—*continued.*

grades, affording a choice of tint, contrast, and weight. This brief synopsis of only the Wellington bromide papers will be sufficient to indicate the wide technical experience at the back of the Wellington factory by which such a variety of materials, all of them of distinctive character, are produced, and year by year maintain and extend their hold upon amateur and professional users alike who must have the best.

The preferences of users of gaslight paper are catered for by the Wellington "S.C.P." (slow contact paper), likewise made in eleven grades, and thus providing the widest choice as regards surface, tint, and contrast. The surfaces include the customary matt and glossy in addition to others of "Porcelain" and "Carbon" surface, as well as "Canvas." "S.C.P." is also made in a series of de luxe grades in two degrees of contrast—"Vigorous," for weak negatives, and "Soft," for strong negatives—each type of paper being supplied in matt, semi-glossy, and glossy surface. For the extremely fine quality of the results, the freedom from fog or stain, and its good keeping qualities, "S.C.P." has naturally taken a high place among British printing papers.

Within the last year or two a further addition has been made to the series of Wellington papers by the "B.B.," a somewhat slower paper than bromide, but one yielding prints of rich warm black tone by simple development. The prints have a particularly refined appearance, and among professionals have been welcomed as an agreeable change from the cold black of ordinary bromide or the warm colour of sulphide-toned prints. The paper is made in six grades—semi-matt, toned matt, and white matt—in each case of both thin and thick substance.

Print-out papers of the P.O.P. and self-toning kind are also distinctive Wellington products, issued in a variety of surfaces, and in paper and card weight.

It is not a matter of surprise that with this great experience and reputation in the manufacture of emulsion printing papers, Messrs. Wellington and Ward should speedily have created a large demand for their plates on taking up this branch of manufacture. The Wellington plates run to a series of a dozen different grades, of which perhaps the most notable is the "Xtreme," a plate of ultra-rapid speed, specially recommended for artificial light exposures or for the most rapid kinds of outdoor photography. The "Xtra-Speedy" is likewise a very fast plate, with somewhat greater tendency to vigour than the "Xtreme," whilst the "Anti-Screen" is an orthochromatic plate serving for the colour rendering of yellows and greens without the use of a light-filter, on which account, in conjunction with its considerable speed, it has become a popular plate with amateurs. The series also includes a lantern plate suited for both black and warm tones, as also an "S.C.P." lantern plate coated with the gaslight emulsion, and providing the convenience and quality already referred to in allusion to the papers of this class. Mention should also be made

of the Wellington X-Ray plate of high speed and fine grain, with which exceedingly fine results have been obtained of difficult subjects.

In one other respect, too, a word should be said of Messrs. Wellington's methods. The firm is one which supplies the most complete working instructions in the use of all their materials in the shape of their "Handbook," dealing exhaustively with the development, etc., of plates and papers. Address: Elstree, Herts.

CAMERAS AND OTHER APPARATUS.

Adams and Co.—As makers of distinctive high-class apparatus, and as pioneers, particularly in reflex cameras, Messrs. Adams hold a premier position. Their cameras are not sold to a great extent through the customary dealing channels, for, highly priced as such high-class instruments necessarily are, it is a fact that their cost to the manufacturer is such as to preclude the very considerable discounts which are customary in respect to the lower-grade and more popularly priced apparatus.

A leading specialty of the firm and one embodying the genius in camera design of Mr. A. L. Adams is the "Minex" reflex, a triumph in the construction of this type of camera. Though exceedingly light and compact, it affords all the movements which are called for in a reflector camera of the highest class in the way of extension, rise of front, range of shutter speeds from 3 seconds to the fastest exposures in addition to time and bulb, whilst it provides these facilities in the simplest possible way. A special feature of the "Minex" is the four-way swing-front, which can be fitted, a movement of the greatest value in a reflex camera. The "Minex" is made in sizes from $3\frac{1}{2}$ by $2\frac{1}{2}$ to half-plate, also in a stereoscopic model. A later introduction is the "Folding Minex," in which precisely the same range of facilities is provided with the added convenience of great portability when folded for carrying. The "Folding Minex" is made in sizes from quarter-plate to half-plate. A somewhat cheaper model of the box pattern of instrument is made in the one size of 5 by 4, and differs only from the full-priced instrument in the omission of some few items which are matters of convenience.

Then we should refer also to the series of "Vesta" pocket cameras made in a series of models from vest-pocket to postcard size, for roll-film and for plates, and fitted, in the case of two models ($3\frac{1}{2}$ by $2\frac{1}{2}$ and quarter-plate), with focal-plane shutter. The whole series is characterised by extreme compactness of construction and reduction of weight, and is of design allowing of ample range of movements. Previously, Messrs. Adams fitted the "Com-

BRITISH RESOURCES.—CAMERAS AND OTHER APPARATUS—*continued.*

pound" shutter to these cameras, but are now making their own between-lens shutter for them. Although pocket cameras, it should be understood that they are instruments of precision permitting the use of the largest aperture lenses and allowing of the finest work being done.

In cameras of the hand stand class there is the Adams "Vaido," made in two models, A with diaphragm shutter, and B with addition also of the "Minex" focal plane shutter. This camera has extreme movements in the way of extension, rise and swing of front, wide-angle movement, finder showing the picture obtained on the plate, and rotating back. Other specialties of the firm are their series of massively built enlarging lanterns, changing boxes holding a dozen plates, and several special patterns of Wynne exposure meter, one of wafer-like slimness and another, also very slim, made in combination with a stop watch. Address: 24, Charing Cross Road, London, W.C.

Aerograph Co., Ltd.—As the original introducers of air-brush appliances for the working up and colouring of photographs, the Aerograph Company have achieved the success which comes to original invention and thoroughness in manufacture. The "Aerograph" brushes are made in a well equipped London factory, in which also are produced other larger patterns of instrument used in other decorative arts and industries. The photographic models have long been recognised as the best of their kind, thoroughly well made, simple in use, easily cleaned, and capable of yielding a spray which can make a sharp line as well as distribute colour evenly over an area. The Company's brushes have been familiarised to users in this country by the skilled demonstrations of their capabilities, regularly given by the managing director, Mr. Charles S. Burdick, the head of the Company, and its prime mover by reason of his two fold genius as an artist and a constructional engineer. A recent accessory for use with the "Aerograph" is a small electric air-pump, giving a higher air pressure than the foot pump, dispensing with labour, and contributing both to the speed and quality of the work. The electric pump maintains the pressure of 30 lbs. as against the 15 or 20 lbs. which many operators will employ with foot-pressure. The result is finer atomising of the colour and softer tinting in the work. The smallest pump of this class made by the Company is for two or three A-pattern brushes, price £15 2s. Address: 43, Holborn Viaduct, London, E.C.

Allan, David. All descriptions of photographic accessories in metal and wood are made by Messrs. Allan in their Whitfield Works, the goods enjoying a large sale throughout the United Kingdom and abroad. The chief lines are dark-room lamps in a whole series of models from the cheapest kind, costing less than a shilling to those of the larger and more elaborate type selling at from £1 to £1 10s. Washers for plates or prints are likewise made in a considerable number of patterns, as are also tanks of enamelled and japanned

BRITISH RESOURCES.—CAMERAS AND OTHER APPARATUS—*continued.*

metal for the development, fixing, and washing of negatives. Folding plate-racks, grooved boxes for negatives, calcium tubes, and other miscellaneous accessories in the shape of dishes, storage tins, and dark-room ventilating fittings are among the well-made goods in which Messrs. Allan have long kept the photographic trade supplied. Address: 107, Mansfield Street, Kingsland Road, London, N.E.

Ashford, J. and Son, Limited.—Tripods for stand-cameras have long been the leading specialty of this old-established Birmingham firm. Ashford's tripods have made a name for themselves for their lightness and extreme rigidity. The original model is still made in a wide range of sizes providing a length of leg from 5 ft. to 9 ft. More recent lighter models are the "Giraffe" and the "Feather-weight Giraffe," the latter a tripod extending to 56 ins. and weighing less than 2 lbs. The most recent of the Ashford tripods is the "Ideal," of wood and aluminium, 56 in. length, closing to 22 ins., and weighing 23 ounces. Mechanically, and in practice, this is a far better type of stand than the Continental all-metal tripods. Address: Aston Brook Street, Birmingham.

Beard, R. R., Ltd.—No British firm has a higher standing in the manufacture of optical lanterns than Messrs. Beard, whose connection with this branch of trade goes back to the days when the oxy-hydrogen limelight was the only illuminant for optical projection. The Beard gas regulator for cylinders of compressed oxygen or coal gas has long been a standard accessory and one which has maintained the highest reputation for reliability in action and durability in use. Messrs. Beard still make several models, as also the special valves and gauges required for the use of compressed gases. The Beard jets for limelight work are also appliances of similar mechanical excellence and efficiency for their work. Another lanternist's accessory which we should not omit to mention is the Beard "Eclipse" self-centring carrier, one of several patterns of lantern-slide carrier, the special feature of which is that a slide of whatever size, English, French or American, is automatically centred on the screen. Like the other carriers it is manipulated entirely from one side of the lantern. Another pattern of carrier automatically darkens the screen during the change of the slide. Of late years Messrs. Beard have applied their long experience as constructors of lantern apparatus in the manufacture of arc lamps and cinematograph projectors. They make both in a series of different models, and are also makers of a portable generator of electric current, actuated by an internal combustion motor burning paraffin or petrol. The self-contained installation is made in a series of sizes ranging from an output of 700 watts to one of 6,000 watts, at prices which range from £50 to £165. Address: 10, Trafalgar Road, Old Kent Road, London, S.E.

Beck, R. and J., Ltd.—Mention should be made in this section of some of the special manufactures of Messrs. Beck, notably the

BRITISH RESOURCES.—CAMERAS AND OTHER APPARATUS—*continued.*

"Cilverex" diaphragm shutters, each supplied with a card giving the exact speeds corresponding with the markings upon the scale which latter for convenience in manufacture are engraved as 1-10th, 1-20th, 1-40th and 1-80th. The "Frena" camera, taking a pack of forty flat films occupies a place by itself among hand cameras, whilst the "Cornex" series of magazine cameras for plates or cut films in sheaths embodies a distinctive type of construction. Messrs. Beck are also makers of the Mariott "Episcopo" lantern for the projection of opaque objects, the instrument being made in a series of models ranging in price from £27 to £265. Address: 68, Cornhill, London, E.C.

Billcliff, J.—This firm of camera makers, established for over fifty years, has for some years past turned its attention more particularly to cameras and other apparatus for the "while-you-wait" branch of photographic business. Its specialties include multiple and repeating-back cameras, printing-frames and machines, enlargers, etc., all designed specially with a view to the rapid production of the midget and larger portraits (up to postcard size) now made upon such an extensive scale in many establishments in populous centres throughout the country. Address: Richmond Street, Boundary Lane, Manchester, S.W.

Brooks Manufacturing Co.—The manufactures of this firm are highly distinctive, consisting chiefly of hand-cameras of altogether special design, among them those for the use of dry-plates without a dark-room by means of a novel form of light-tight metal sheath for a pair of plates. Address: James Street, Sale, Manchester.

Butcher, W., and Sons, Ltd.—A volume might be filled with descriptions of the many types of hand and stand-camera designed by Messrs. Butcher, for the firm's full catalogue of photographic requisites runs to 1,360 pages. Here we may single out one or two series of cameras and other apparatus, prefacing a reference to them with a mention of the fact that Messrs. Butcher some time ago pooled their manufacturing resources with those of Messrs. Houghton's by forming a separate company, the Houghton-Butcher Manufacturing Company, Ltd. This latter manufactures for both Messrs. Butcher and Messrs. Houghton's, each of which firm, however, remain separate as regards the design and marketing of their productions.

One very popular series of cameras is the "Cameo" for plates, made in a series of models of single and double extension and of size from $3\frac{1}{2}$ by $2\frac{1}{2}$ to postcard. These cameras have a strong, light, back body of wood, whilst the baseboard and other fittings are of light metal, the U-form front being of great strength and rigidity and affording ample rise to the lens. The fittings include hooded focussing screen, bushes for attachment to a tripod, brilliant finder, and diaphragm shutter, the latter varying with the price of the outfit.

BRITISH RESOURCES.—CAMERAS AND OTHER APPARATUS—continued.

The whole finish of the cameras is exceedingly good, and the appearance attractive from the excellence of the enamel and nickel work. In the "Klimax" series, also for plates, a somewhat more solid construction is adopted, and one affording a wider range of movements. Here the sizes run from quarter-plate to half-plate in both single and double extension, whilst a model is made in quarter-plate and 9 x 12 cm. size with a specially large front to accommodate an $f/4.5$ lens.

In roll-film cameras Messrs. Butcher have their series of "Carbines" replete in every particular with the movements of shutter, focussing, finder, and film spools which are expected nowadays by users of roll-film. The cameras are of light but strong construction, very substantially and rigidly made, and of handsome appearance. They are made in a series of sizes from $3\frac{1}{2}$ by $2\frac{1}{2}$ to half-plate, a number of the models being regularly made for the use also of plates in single metal slides. The series includes instruments of double-extension pattern, the latter representing as completely an equipped camera of the portable type for use with either film or plates which could be designed.

In enlarging apparatus Messrs. Butcher have a series of excellent instruments ranging from the very cheap fixed-focus enlarging boxes to a series of enlarging lanterns, one notable feature of which is the smooth adjustment, by means of a chain and sprocket instead of rack and pinion, of the lens front and the lantern body. Apart from the smoothness of this movement there is the further advantage that the controlling head can be put at the front of the extending baseboard, and thus is most conveniently placed (near to the easel) for ease in focussing. These enlargers, according to the price, have a more or less full range of movement of the negative in its stage, but all are exceedingly well made and priced at extremely moderate figures. In one model, the "Abbeydale," a special form of negative carrier is provided, in which, by a series of opaque blinds, the negative can be masked down to any required extent. The enlargers are also made in a series of miniature models for use with negatives up to $3\frac{1}{2}$ by $3\frac{1}{2}$ in., although larger negatives (up to quarter-plate) may be inserted for enlargement of part thereof. The whole range of instruments shows a very practical acquaintance with the requirements of the amateur worker.

We should also mention the firm's series of cinematograph lantern. In addition to the full professional model, the "Silent Empire," a specialty of Messrs. Butcher is a series of projectors suitable for home cinematography, in which the source of light is obtained either from the house supply (in which case a small arc lamp may be used) or from an accumulator supplying a high-power metal filament focus lamp. In the case of two models the instruments can be used for the projection of ordinary lantern slides as well as for cinema film. As we have seen for ourselves, these very moderately-priced cinematograph projectors afford a well-illuminated and steady picture within the limits of home use for which they are intended. Address: Camera House, Farringdon Avenue, London, E.C.

BRITISH RESOURCES.—CAMERAS AND OTHER APPARATUS—*continued.*

Camera Construction Co.—Photographic apparatus and minor accessories in wood are made in this firm's own Hackney factory in very considerable variety. The list of goods includes a series of stand cameras marketable at very moderate prices and including both the light, taper-bellows field camera with a full range of movements and the heavier square bellows pattern. The firm has also several models of studio camera and makes a special design of repeating back. Folding tripods and stands for studio cameras are also among its manufactures, its facilities also enabling it to deal with the wholesale production of any of the smaller wooden photographic accessories such as printing-frames, retouching desks, draining racks, negative boxes, lantern slide carriers, and bromide printing machines. Address: Eagle Works, Durham Grove, Hackney, London, N.E.

Dallmeyer, J. H., Ltd.—Although essentially optical manufacturers, Messrs. Dallmeyer have made a place for themselves as makers of apparatus chiefly through the excellences of their "Correspondent's" camera, an admirable pattern of the hand-stand instrument, and of the cabinet attachment for studio cameras, the latter a valuable auxiliary for the portrait photographer, inasmuch as it provides an exceedingly quick removal of the focussing screen and its replacement by the plate uncovered and ready for exposure. In addition there are one or two other Dallmeyer specialties such as the firm's studio flap shutter, catches for dark-slides, and time exposure valves. Address: Church End Works, Willesden, N.W.

Furse, W. L.—The war has been responsible for few new businesses, but one is being started by Mr. W. A. Furse, well known in the home photographic trade from his sixteen years' connection with a firm handling the products of a German house. Mr. Furse is taking up manufacture on his own account, and is hoping to have a series of cameras and accessories ready for the market by the spring of 1916. Address: 33a, Kenmore Road, Hackney, London, N.E.

Gandolfi, L.—Although among the smaller makers of high-class cameras, Mr. Gandolfi has a thirty years' experience in the making of field and hand-stand cameras for use at home and abroad. Two standard patterns of his are the "Tallbody" universal field-camera for all round studio and outdoor use, and a *de luxe* model of hand-camera, embodying all the movements of a stand instrument with the convenience and portability of a camera for use in the hand. Address: 84, Hall Road, Peckham Rye, London, S.E.

Griffin, John J., and Sons, Ltd.—Although not themselves manufacturers of photographic apparatus, mention should be made here of certain articles issued exclusively by Messrs. Griffin, for whom they are specially made. Among these is a bromide printing box

BRITISH RESOURCES.--CAMERAS AND OTHER APPARATUS--*continued.*

in which the light (electric) is supplied by a dry battery, boxes for the convenient storage and use of bromide paper, a bevelling machine for the finishing off of mounting boards as used for sketch portraits, wooden developing tanks for professional use, die presses for the stamping of mounts and prints, in addition to a variety of styles in studio furniture. Address: Kemble Street, Kingsway, London, W.C.

Hora and Co.--Field and studio cameras have long been specialties among the supplies of Messrs. Hora and are now made by them, the former in two models, one of the substantial square-bellows pattern and the other of a lighter taper-bellows type, with a very wide range of movements. The square bellows pattern, by its solid construction and ample extension and front movements makes an excellent studio camera, particularly when fitted with the special pattern of repeating-back which Messrs. Hora make for it in sizes from 15 by 12 to whole plate. Mention may also be made of the firm's dark-slides made to fit various well-known cameras and also of their roller-blind shutters, made in sizes up to 5 in., in addition to a stereoscopic pattern. Address: 346, York Road, Wandsworth, London, S.W.

Houghtons, Ltd.--Recruiting and disturbance in the purchase and transport of materials in the Government service have naturally had a very great effect upon a large manufacturing concern such as the factory of Messrs. Houghtons at Walthamstow, London, E., or, to speak more correctly, the factory of the Houghton-Butcher Manufacturing Company, representing the amalgamation of the manufacturing interest of these two large firms. But even greater than these have been the demands upon the factory itself in the supply of goods for various Government departments. It will be understood that with such insistent claims upon their resources Messrs. Houghtons have consequently not been able to maintain the supply of all the many varieties of photographic apparatus which for some years now they have manufactured from first to last. These modified conditions, however, can only be temporary, although we would rather be excused from any precise prophecy of the date on which a return to normal times will take place.

Nevertheless, no review of the British resources in the manufacture of photographic apparatus would be complete without some adequate description of the many varieties of goods which are among the customary output of the Walthamstow factory, inasmuch as these constitute a very important proportion of the British productions. Of late years the tendency in camera construction, so far as Messrs. Houghtons are concerned, has been in the direction of folding cameras for plates and film of a distinctly higher class. The series of "Klito" and "Ensign" cameras represent a very wide range of instruments, which, while they include many quite inexpensive patterns, also mark the policy of the firm of supplying instruments which in their reliability, con-

BRITISH RESOURCES (CAMERAS AND OTHER APPARATUS—continued)

venience, performance, and finish are of a very high grade Messrs Houghtons have shown that all British hand cameras in which pressed and stamped metal work is an important part can more than hold their own with those of Continental origin.

A notable production of Messrs Houghtons is the "Ensignette" all-metal film camera made in a series of models, issued at prices which represent production upon a very large scale. The "Ensignette" pattern has also been adopted in somewhat larger cameras with a wooden instead of a metal body. The folding focal plane camera is likewise among the firm's manufactures, as are also the various patterns of box magazine cameras for plates and box cameras for film. And to these must be added a whole series of stand and hand stand cameras among them the redoubtable "Sanderson" with its extreme range of movements embodied in both types of instrument. Finally, there are reflex cameras of which Messrs Houghtons are the producers in several models of box form, and in one the "Ensign Folding Reflex" in which the bulk of the instrument when closed is very little more than that of a folding focal plane.

To mention only one or two other classes of apparatus in which Messrs Houghtons have long established a reputation for high class workmanship and moderate price we would refer to their studio cameras and stands, to collapsible tripods for field cameras, to their extensive series of enlarging boxes and lanterns and to other accessories such as printing frames and printing machines. The firm's full list running to 1086 pages fully describes these many pieces of apparatus in detail and does not overstep the mark in its references to their sound construction and all British manufacture. Address 88 and 89 High Holborn London W C.

Hughes, W C, and Co Messrs Hughes are one of the oldest manufacturers of optical lanterns and necessary apparatus for optical projection. We recollect the purchase in the long ago days of our youth of their "Pamphengos" lantern then the best of its kind and remarkable for the great power of light obtained from a four wick paraffin lamp. The "Pamphengos" is still one of the firm's specialties, and no doubt of great value in places where other illuminants cannot be had. But paraffin as a source of light has been largely eclipsed by the firm's "Luna" light, an incandescent mantle burner of very great power burning methylated spirit, which is vaporised from a small boiler, itself heated by a small methylated spirit flame which can be readily adjusted. The lamp is entirely self-contained will fit practically any lantern and comes not very far short of limelight in power. It would be impossible to review the many patterns of optical and cinematograph lanterns made by Messrs Hughes but we may single out for mention their instrument specially designed for the projection of Autochrome colour transparencies, in which special steps are taken to keep the transparency cool when using arc light. The lantern is kept of small

BRITISH RESOURCES.—CAMERAS AND OTHER APPARATUS—*continued*

size by the use of rectangular condensers another of the firm's specialties, among which latter also are a large number of jets dissolvers lantern stands in short almost every item for optical projection upon the large or small scale Address 82, Mortimer Road Kingland, London N

Infallible Exposure Meter The convenience of the Wynne pattern of exposure meter has long been an article of faith among photographers The standard pattern of the Wynne meter is well known but there is now a slimmer and in some respects more convenient pattern of the hunter watch type the test paper and the two standard tints being placed upon a separate dial which bears also the table of factors for subjects other than the standard one with a moderately strong foreground The Infallible Meter Company have also a convenient form of actinometer for use in printing by the carbon or platinum process also simple apparatus of the pendulum pattern for determining the speeds of shutters Address Wrexham

Kamm, L. and Co Cinematograph lanterns and cameras are made in a wide range of patterns by Messrs Kamm, one of their latest models being a projector in which the film may be kept stationary in the gate without danger of its catching fire, thus allowing of the stationary picture being examined at leisure on the screen Such a feature as this is of particular value in the use of the cinematograph lantern or lecturing or educational purposes In the case of the "Kamm" lantern the film may be arrested by the operator himself the mechanism being electrical Another specialty of Messrs Kamm's is a portable oxygen generator The gas is made by heating cakes of chlorate of potash and oxide of manganese, the make of gas taking place whilst the lantern is in use The weight of the generator and the special carburetter jet for use with it is 39 lbs and the price £15 10s Address 27, Powell Street Goswell Road, London, E.C.

Kershaw, J. and Sons, Ltd One of the finest factories for the manufacture of high grade photographic apparatus is that of Messrs Kershaw at Leeds the firm's resources including press tool work, precision tool work, and cabinet making of a high character Government contracts at the present time naturally are absorbing all the energies of the factory but it may be hoped that before long Messrs Kershaw may be able to resume upon a still larger scale their manufacture of cinematograph projectors and accessories and photographic cameras including their distinctive and highly efficient reflex instrument which has gained wide popularity for its reliability and "popular" price using the word to indicate a price much below those of the most costly reflexes and not very much in excess of those of the cheaper class of camera Messrs Kershaw are also makers of electrical appliances, science lanterns and accessories, etc., in addition to other apparatus

BRITISH RESOURCES.- CAMERAS AND OTHER APPARATUS- *continued.*

which comes within the term "scientific instruments." Address: 76, Woodhouse Lane, Leeds.

Lancaster, J., and Son, Ltd.—Messrs. Lancaster were pioneers of amateur photography more than 30 years ago, being one of the first firms in the country to issue comparatively inexpensive apparatus for the amateur worker. Many old hands of the present day will call to mind the "Instantograph" or "Merveilleux" camera with which they started in the eighties of the last century. These names still figure in Messrs. Lancaster's list although the instruments themselves have been improved and re-modelled out of all recognition. The full series of Lancaster cameras embraces those of both the hand and stand class including a number of pocket instruments. Another special line of Messrs. Lancaster is a series of enlarging lanterns of the customary type as well as their "Ellipsoid" series, in which the illumination is by artificial light (either gas, acetylene, electric or magnesium) produced from a reflecting surface of special curvature. This "Ellipsoid" system, which has been a very popular one among amateur enlargers, is embodied in a complete lantern; or the illuminating boxes may be bought separately for use with the photographer's own camera. Address: 87, Parade, Birmingham.

Lizars, J. Hand-cameras in a number of distinctive designs are among the manufactures of Messrs. Lizars, who may be said to have covered ground in camera manufacture which other makers have not so fully explored. For example, the series of "Challenge" folding hand-cameras include a number of models in which the purchaser has the choice of a plate which is in either the upright or horizontal position when the camera is held in the normal way. Some may prefer to make the bulk of their pictures of upright form, others of landscape shape; they can suit themselves particularly well from the "Challenge" series. In stereoscopic hand-cameras Messrs. Lizars have likewise produced a whole series of models, and they are also one of the firms who have actively turned their attention to the manufacture of cameras specially designed and made for use in the exacting conditions of tropical climates. These various instruments include both film and plate cameras, as also a series of "De Luxe" hand-cameras possessing the full range of movements in the way of long extension and rise of front, swing-front, swing-back, and wide-angle movement demanded by those who require the full facilities provided in a stand pattern of camera to be at their disposal in an instrument equally suited for use in the hand. We should not omit to make mention also of the Lizars series of reflex cameras, including a "De Luxe" model fitted for stereoscopic work. Address: 101 and 107, Buchanan Street, Glasgow.

Mackenzie and Co. were the original introducers of the system of carrying dry-plates in a series of light-tight envelopes, each of

BRITISH RESOURCES.—CAMERAS AND OTHER APPARATUS—*continued.*

which, by the use of a single "adapter" (of bulk and weight not more than that of a double dark-slide), can be exposed in the camera. This "Mackenzie Wishart" system is one which has gained considerable popularity on account of the facility with which a photographer may carry a very considerable number of plates for exposure without encumbering himself with a corresponding number of dark-slides. Messrs Mackenzie manufacture the envelopes of suitable strength and pattern, as also the adapters in models capable of being readily fitted to any type of camera. Address: 212, Old Dumbarton Road, Glasgow.

Marion and Co., Ltd.—So far as their manufacture of apparatus is concerned, Messrs. Marion's interests are chiefly in the production of appliances for the professional photographer, in which connection their series of "Soho," "Special," "Universal," and "Excelsior" studio cameras may be mentioned as representing a range from the most elaborate type of studio camera to that of a simpler description issued at an extremely moderate price. Mention should also be made of the "Hana" studio stand, with its great facility for rapid working and wide range of movement—40 within 2 ft. of the floor and to a height of 7 ft. Similarly, the making of studio furniture and accessories such as those for the display of portrait specimens is a special department with the firm, as is also the manufacture of installations, large and small, for artificial illumination in portraiture. The "Boardman" system of arc lighting for studio portraiture is one which has been adopted by many studios in the very front rank, but Messrs. Marion's electrical department has specialised for some years past in all descriptions of electric lighting for studio work and for other branches of photography, such as enlarging, printing, and copying. One special appliance is the "Boardman" arc enlarging cabinet, in which the illumination of the negative is entirely by a powerful reflected light, with its advantages of evenness and avoidance to a very large extent of the disfigurement of enlargements by retouching work upon the negatives. Address: 3, Soho Square, London, W.

Moore, George S.—The special requirements of the "while-you-wait" photographer, and of those requiring to turn out prints quickly and in quantity are specially catered for by several pieces of apparatus designed and made by Mr. Moore. These are a strip printing frame serving for the rapid exposure in succession of six impressions from the negative upon the single strip of bromide paper; a bromide exposing box exceedingly well made in metal and suitable for use with either gas, oil, or electric light; and a self-contained enlarger for "while-you-wait" portraits, provided with dry battery and two small lamps, and designed for use with the strip printing frame in the rapid production of enlarged portraits in postcard form. These and one or two other specialities for the same class of photographic business have met with a wide sale due to their entirely practical design and workmanlike construction. Address: 69, Denmark Hill, Camberwell, London. S.E.

BRITISH RESOURCES.—CAMERAS AND OTHER APPARATUS—*continued.*

Moore and Co.—Another firm which specially caters for the "while-you-wait" photographic trade. Its manufactures include repeating-back cameras for panels, postcards, midgets, etc., printing-frames, and other appliances. Address: 101 and 103, Dale Street, Liverpool.

Moss, R. J., and Sons.—Acetylene generators and accessories have been the special business of Messrs. Moss for a time which dates back pretty well to the introduction of this illuminant, following on the commercial manufacture of carbide of calcium. In that time Messrs. Moss have designed and continue to make in their own works a very wide range of acetylene generators, lamps, and other accessories such as purifiers and burners for enlarging and optical lanterns, etc. For photographic use the "Mosa" generator is the most suitable for enlarging and for lighting; the "Moss-Abingdon," where the light is required for lantern projection. These generators work with ordinary lump carbide, are specially free from the defect of "over-making" (hence are free from odour due to escape of unburnt gas), and have been employed with every satisfaction in all parts of the world. Messrs. Moss's list is, in fact, a complete guide to the selection of apparatus for the use of acetylene, the firm's long practical experience of this trade being probably second to that of no other manufacturer. Further pieces of apparatus made by them are self-contained lamps for indoor and outdoor use, the acetylene generator forming part of the lamp. These lamps range from small hand instruments costing a few shillings to large flares for outdoor work costing from £3 to £4. A special list describes them fully. Address: 98, Snow Hill, Birmingham.

Newman and Guardia, Ltd.—To no firm's productions, perhaps, can the champion of things British point with such pride as to those issued under the familiar trade initials of "N. and G." For many years Messrs. Newman and Guardia have applied themselves exclusively to apparatus of the highest class. They have left manufacture in bulk alone, and have devoted themselves to apparatus which in design and superlative excellence of workmanship has been distinctively their own. It is hardly necessary to refer at length to the "N. and G." reflex camera, which has gone through several stages of development, but for some years past has been issued with scarcely any modification, since, broadly speaking, it is capable of no further improvement. While the original form of construction is retained, the later developments have been in matters of detail and convenience which render the camera quicker in operation without any sacrifice of the reliability and lasting quality which have consistently been features of the firm's apparatus.

N. and G. workmanship, however, has obtained far wider popularity through the series of "Sibyl" pocket cameras, now made in a considerable number of models and sizes. The "Sibyl," on its

BRITISH RESOURCES.—CAMERAS AND OTHER APPARATUS—continued.

first introduction, was the first real pocket camera; that is to say, an instrument which was no encumbrance in the pocket, and within a second or two of removal from the latter was all ready for the taking of the photograph. The construction is distinctive, embodying a very rigid lazy-tongs support for the lens-front, a particularly smooth focussing movement without rack and pinion or winch-screw, and a type of lens-front which allows very great rise of the lens each way of the plate. The almost human facility with which the lens-front comes into position for focus for any required distance on opening the camera is a thing to be experienced. In matters of detail also the camera is exceedingly well provided, notably in the adjustment by which the correct picture obtained on the plate when the front is raised is shown in the finder. The "Sibyls" are made in a series of sizes from postcard to vest pocket (45 x 60 mm.). The latter is issued as the "Baby Sibyl," and is made in two models, one for plates and the other for roll-film, as are also the $3\frac{1}{2}$ by 2 $\frac{1}{4}$ and quarter-plate sizes. In the plate models the usual single metal slides may be used or the double metal slides of Messrs. Newman and Guardia's own recent design and manufacture. Any plate "Sibyl" is also adapted for the use of a film-pack.

For those who favour a folding camera of the hand-stand type there is the "Trellis," with its wide range of movements and convenient rotating back. It is made in one size only—namely, quarter-plate—but in two models, one with focal-plane shutter forming part of the back. A word should be said upon the accuracy of the speeds marked on N. and G. shutters, a feature of the firm's productions to which many independent experts have borne witness. Address: 17 and 18, Rathbone Place, Oxford Street, London, W.

Newton and Co.—For more than two hundred years Messrs. Newton have existed as a firm, and for many years past have taken a leading place as producers of lantern-slides and of apparatus for optical projection. In their own works they manufacture projection lanterns of all descriptions, from those of the simple kind suitable for home use to the most elaborate installations adapted for the purposes of a university or public institution. Their resources extend beyond the lanterns themselves to the many appliances connected, chiefly, with illuminants. Lime jets and many patterns of arc-lamp are among these latter, and more recently lamps specially designed for the use of oxy-acetylene in conjunction with an incandescent pastille and dispensing with the use of a condenser. This form of light, which is self-contained, has come considerably into use for projection upon the largest scale. Address: 72, Wigmore Street, London, W.

Ross Ltd.—Although for fifty years photographic objectives have formed a staple part of Messrs' Ross's optical business, yet the manufacture of a few patterns of cameras has been regularly under-

BRITISH RESOURCES --CAMERAS AND OTHER APPARATUS--continued

taken. Of these perhaps, the one which should be most prominently signalled in this notice is the "Panros" a camera of the folding focal plane pattern made in the quarter plate, 5 x 4, post card and half plate sizes, and also in a tropical model (bass bound took) in the 5 x 4 in and 9 x 12 cm sizes. The camera has the distinctive feature of a self capping shutter, which works at constant tension, the various speeds being obtained by a very simple adjustment for altering the width of the slit. The shutter gives a full range of instantaneous speeds as well as automatic time exposures from $\frac{1}{2}$ to 3 seconds or for any longer period by means of pneumatic release.

Another notable pattern of high class camera is the "Keros" a camera of the hand stand pattern of the very fullest range of movements. Another specialty is the twin lens pattern of reflex, still a form of camera which is a favourite with some workers, whilst among the larger patterns of camera Messrs. Ross manufacture a light model field camera under the name of the "Century," also one of the more substantial square bellows pattern as well as a studio instrument of the most massive description, and fitted with all the necessary adjustments for convenient use in portraiture. In none of these models can it be said that any concession has been made on the score of cheapness. The instruments without exception are examples of the finest workmanship. Address 3 North Side Clapham Common London, S.W.

Sanger, Shepherd and Co. Ltd. No review of the manufacturing resources of Great Britain in photographic apparatus would be complete without adequate mention of some few of the specialties in apparatus of the highest class and in appliances for the scientific photographic experimenter designed and made by Messrs. Sanger Shepherd. These include a number of patterns of camera and repeating back for colour photography by the three colour process, in which branch of work the firm has for many years taken a leading place. Light filters and holders therefor for orthochromatic and three colour photography are also made in a full range, whilst among the scientific appliances must be mentioned instruments for density measurement plate speed testing photo spectroscopy, and colour sensitometry. Among these is apparatus for the Hurter and Driffield system of speed testing as also the convenient speed-testing plate designed by Mr. Chipman Jones. Address 5, 6, and 7 Gray's Inn Passage Red Lion Street London W.C.

Sinclair, James A. and Co. Ltd. Although one of the younger firms in the manufacture of apparatus Messrs. Sinclair have quickly built up a large business in a somewhat limited range of cameras, etc. of the highest class. Their success has been due to the wide practical experience of Mr. James A. Sinclair, one of our most accomplished amateur workers, and to the mechanical genius of his colleague, Mr. Arthur S. Newman to whose skill as a designer the early patterns of the "N and G" cameras such as the

BRITISH RESOURCES.—CAMERAS AND OTHER APPARATUS—*continued.*

"Special B." and the "N. and G." reflex owed their high reputation for efficiency and reliability. One of the chief specialties of the Sinclair firm is the "Una" series of cameras, of the hand-stand pattern, extremely convenient as a hand-camera and yet possessing all the range of movements required in a camera for use on a tripod; yet one also which is remarkably free from mechanical complications, and thus is most "handy" in use. To these good qualities must be added that of fine workmanship. This camera is still being produced and sold, but in the case of other specialties, involving more metal work, Messrs. Sinclair's output has been practically suspended by the demands of the Government. Still we should mention the "N. S." reflex camera, a distinct type of instrument since the shutter is placed in the lens, Messrs. Sinclair being great believers in dispensing, when possible, with the focal-plane type of shutter. Another specialty is the N.-S. "Accurate" shutter, the first photographic shutter to be sold with an official certificate (that of the National Physical Laboratory) of its real speeds. Another original instrument is the N. S. "Kinema" camera, embodying many new features in a camera for cinematograph work and constructed for the most exacting requirements of cinematograph operators. The camera includes a reflex focusing attachment, affording a visible same-size image of the picture obtained on the film. The N.-S. reflex was the camera employed by Mr. H. G. Ponting in his extremely fine cinematograph work for the Scott National Antarctic Expedition. Address: 54, Haymarket, London, S.W.

Staley, Shew and Co.—The title of this firm marks the recent amalgamation of the businesses of Messrs. J. F. Shew and Co., and Messrs. Staley and Co., late of 24, Tavies Inn, Holborn Circus, London, E.C. The combined firm is continuing the manufacture of the "Xit" series of pocket cameras, long associated with Messrs. Shew, who were the originators of this very reliable type of instrument. Reflex cameras likewise remain prominently among the firm's manufactures, since both Messrs. Shew and Messrs. Staley were separately specialists in cameras of this type. Shew reflex cameras have long been favourites with Press photographers, whilst the "Britisher" reflector cameras (previously of Messrs. Staley) will be further improved by embodiment in them of some of the features of the Shew. Mr. Walter Dockree, designer and patentee of the "Britisher" reflexes, has joined Messrs. Staley, Shew and Co. and has complete charge of the construction of the various instruments. A new introduction which is promised is a folding focal-plane camera fitted with a shutter similar to that provided with "Britisher" reflexes. Address: 88, Newman Street, Oxford Street, London, W.

Taylor, Tunnicliff and Co., Ltd.—From the outset of the dry-plate process photographers have been well provided in the matter of porcelain dishes. For twenty years Messrs. Taylor, Tunnicliff

BRITISH RESOURCES. CAMERAS AND OTHER APPARATUS—*continued.*

have taken the leading place in the manufacture of dishes, issued under the trade mark "Granitine," of special body and hard porcelain glaze for photographic use. The smoothness of the material of the "Granitine" dishes and their immunity from action by developers, etc., have made them standard articles. Messrs. Tunnicliff also make a number of special patterns of dish, for example one with a well which allows of the plate being readily and easily flooded and also of being most quickly removed from the dish. Their series of "Granitine" tanks for the development, fixing, and washing of plates have likewise found great favour for their high quality and practical design. The latest addition to the series of dishes is one for the development of half-a-dozen plates of stereoscopic size provided with stops to prevent the plates slipping over one another. Address: Eastwood, Hanley, Stoke-on-Trent.

Thornton-Pickard Manufacturing Co., Ltd.—The Thornton-Pickard Company is one of the few British concerns which have laid themselves out for the manufacture of photographic apparatus upon a large scale. In the early days of its history it made a great name for its roller-blind shutter at a time when appliances for the rapid exposure of plates were very much less highly developed than they are now. But since then it has extended its borders in a great number of directions and has manufactured upon a scale which has made it possible to market apparatus at prices which would have been considered uncommercial in the old days of more restricted production. The firm's roller-blind shutter still maintains its position as a piece of apparatus of great reliability and efficiency, as witness the use of it by Mr. H. G. Ponting for his work in the Antarctic. Fashion, however, has largely changed, and always in the direction of greater portability, a movement which the Thornton-Pickard Company have closely followed by taking up the manufacture of all metal pocket cameras and making them with all their accessories, such as diaphragm shutters, finders, etc., in their own works. For the forthcoming season they have in fact largely remodelled their series of cameras of this class by preparing for the market five new models, ranging from quite inexpensive instruments to one of elaborate type, and providing all the movements and finish which are demanded nowadays in this class of apparatus. They have also effected a further considerable improvement in their well-known "Special Ruby Reflex," having succeeded in greatly reducing its size without sacrificing any of its essential features. The "Special Ruby Reflex," it should be said, is not the only model of reflector camera made by the Company; there are other still more inexpensive patterns, including the reflex attachment sold for use with an ordinary folding camera which thus provides the full facilities of a reflex. In cameras of the hand-stand type, the Thornton-Pickard Company have likewise a series of folding "Ruby's" provided with the full range of movements customary in stand-cameras. Among these is a focal-plane model, having a shutter

BRITISH RESOURCES.—CAMERAS AND OTHER APPARATUS—*continued*.

of this type in addition to that on the lens. The purely stand instruments cover a still wider range from the "Tribune" and "College" sets issued at most moderate prices, the "Imperial" outfits which likewise mark extraordinary value for money, to the most elaborate of the instruments, the "Royal Ruby," of triple extension, great rise and swing of front, swing back, wide-angle movement, in fact with all the adjustments, ordinary and extraordinary, which a camera can have.

In enlarging lanterns, too, the house-mark "T.P." figures on a whole series of patterns, from those of small price adapted for the use of the worker's own hand-camera to others of more elaborate pattern, with every convenience by way of rack-and-pinion adjustment for focussing, moving the light, and placing the negative in its stage. A special feature of the "T.P." enlargers is the provision of a small ruled, transparent disc in the negative stage enabling the user to obtain sharp focus on the easel without the necessity of inserting a test plate for the purpose. This description merely glances over the many good features of "T.P." enlargers, for the makers have embodied many excellent original ideas, among them special means for using an enlarger to the best advantage as a projection lantern. Address: Altrincham, Cheshire.

Tress Co.—A firm which for many years past has been active in the manufacture in its own shops of certain special lines in photographic apparatus, more especially those for the professional photographer, should be included in this series of notes. The Tress Company have issued a very neat form of studio accessory in the shape of an exhibiting cabinet, about the size of a small overmantel, but, by means of hinged panels, providing some seven spaces for the display of specimen portraits, quickly available for the customer's inspection. Another item is a hand-fed printer for bromide and gas-light work of a specially convenient pattern. For artificial-light portraiture the firm makes a lamp, the "Surelight," employing a combination of incandescent gas and flash powder and serving excellently for single figures or small groups. They are also suppliers of all descriptions of apparatus for the technical part of the cinematograph trade as also of programme boards, illuminated signs, and numerous other accessories for cinema theatres. Address: 4, Rathbone Place, Oxford Street, London, W.

Victor Co.—Appliances for the special use of the professional mounter are made by the Victor Company. One is a mount-cutter for the production of cut-out mounts of any desired shape of cut-out—oval, circle, or square. This tool is exceedingly well made in beech wood, and extremely efficient for its purpose. The price is 15s. Another appliance is a beveller for the outside edges of mounts, capable of bevelling mounts of any thickness with a beautifully clean cut and very easily operated. It is made in four sizes giving cuts from 15 to 30 ins. at prices from 17s. 6d. to 30s. Address, 2, The Parade, Enfield Highway, Middlesex.

BRITISH RESOURCES.—CAMERAS AND OTHER APPARATUS—continued.

Watkins Meter Co.—The Bee exposure-meter, of which many thousands have been sold, is so well known throughout the world that it deserves to be stated that the manufacture is carried out in the little factory established by Mr. Watkins at Hereford as the outcome of his work in providing all kinds of valuable aid in the exposure and development of plates. Although the standard Bee meter is the "best seller" of the Watkins meters, there is also a steady demand for other models of the meter issued separately for colour photography, interior work, and focal plane exposures, as also for the cylindrical pattern of meter which was that originally issued. For use with any one Bee meter, the Company supply special dials, adapting the meter for the particular branches of work just mentioned, and in addition for studio and snapshot photography. Dials are also sold marked in accordance with the U.S. system of diaphragm numbers. Another special article also made at Hereford is the Watkins daylight "Time Tank," with its distinctive feature of holding the plates in a horizontal position during development. Readers and buyers abroad should note that Watkins instruction booklets can be had in French, Spanish, Portuguese, Italian, Swedish and German. Address: Imperial Mills, Hereford.

Watson, W. and Sons, Ltd.—Perhaps no field camera has ever secured or more fairly deserved the approbation of professional workers than the Watson "Acme," notable for its wide range of movements, its simple construction, and its lightness and compactness, as well as for the fine quality of its workmanship. The "Premier" is Messrs. Watson's pattern of camera in the heavier square-bellows model, serving for both field and studio use—in the latter application with the addition of a repeating-back. Messrs. Watson likewise make a de luxe studio camera and stand of the most elaborate pattern, of excellent design, practically and mechanically, and marking a very high degree of workmanship. Reference should also be made to the firm's "Alpha" hand-stand camera, and to their "De Luxe" enlarging lantern, an instrument of specially solid build and of design which renders it suitable both for enlarging and for the making of lantern-slides by reduction. Address: 313, High Holborn, London, W.C.

Westminster Engineering Co., Ltd.—The arc lamps manufactured by the Westminster Engineering Company in their Willesden factory have attained widespread use for various purposes. Chief among these, perhaps, must be placed the Westminster enclosed arc for studio portraiture, a form of lamp which provides a most actinic light and allows of regular professional portraiture by artificial light being done at a moderate outlay in the first instance. The lamp has been followed by an improved model, the "Top-light," designed for studios which may lack sufficient head room. A further lamp is one (No. 131) of small size adapted for use to the number of five or six in place of one or two of the larger arcs in.

BRITISH RESOURCES — CAMERAS AND OTHER APPARATUS *continued*

studios where a more diffused type of illumination is preferred. For enlarging and projection the company also manufacture some most convenient and inexpensive lamps (Nos 125 and 126) of the semi-enclosed type serving admirably for enlargement upon a considerable scale, and being equally adaptable for lantern projection. These lamps cost from £2 15s to £3 17s. Other members of the Westminster series of arcs are those (Nos 127 and 119) for three-colour process work, photographic printing, etc. No 127 is specially made to give a white light for colour or a highly actinic light for black and white. In all respects the Westminster lamps have secured a high reputation for great efficiency and thoroughly good workmanship. Address: Victoria Road, Willesden Junction, London N.W.

Wilkinson J and L. As manufacturers of wood appliances for photographic use Messrs Wilkinson are perhaps most widely known for their printing frames, articles of which they are leading makers. The Jy Noy non-slipping frame is one which deservedly has obtained the widest popularity due to its excellent pattern and good workmanship. These same qualities are characteristic of other articles of woodwork manufactured by Messrs Wilkinson. Address: 6 St Oswald Street, Rochdale Road, Manchester.

SECOND HAND APPARATUS

In one respect perhaps the photographic trade in Great Britain differs from that in any other country namely in the number of firms specially lying themselves out for the purchase and sale of used apparatus. Probably this trade originally obtained its firm establishment as the result of the fine workmanship of the cameras made by British makers in the old days. A camera by Mare, Meagher or Morse was one which in ordinary circumstances would never wear out; hence it was natural that there should be buyers of instruments which had had considerable use. The trade in second hand apparatus, however, has extended itself far beyond such limits as these, and now covers all descriptions of camera from the compact vest-pocket instrument to the lordly studio outfit, as well as lenses of all kinds, enlargers, tripods, and even many minor accessories.

Therefore we should mention the chief firms engaged in this business, adding the comment that without exception they are suppliers also of every description of new apparatus. These firms are — R. Ballantine, 99, St Vincent Street, Glasgow, Charles Baker, 244, High Holborn, London, W.C., City Sale and Exchange, 81, Aldersgate Street, London, E.C. 94, Fleet Street, London, E.C. 54, Lime Street, London, E.C. The Arcade, Broad Street, E.C., and 26 and 28, King's Road, Sloane Square, London, S.W., Doughty's, 47 48, Navile Street, Hull, Horne's Photographic Exchange, 4b, New Broad Street, London, E.C., and 32, Gracechurch Street, London, E.C., Mason's Photo-

Stores, 13-15, Queen Victoria Street, Leeds, and 54-62, Godwin Street, Bradford; Sands, Hunter and Co., Ltd., 37, Bedford Street, Strand, London, W.C.; Service Company (London), Ltd., 289 and 293, High Holborn, London, W.C.; Arthur Spencer, 41, Harrow Road, Edgware Road, London, W.; Watson's, 84, High Street, Sheffield; and Westminster Photographic Exchange, Ltd., 119, Victoria Street, London, S.W. and 111, Oxford Street, London, W.

PHOTOGRAPHIC LENSES.

Aldis Bros. Messrs. Aldis have justifiably made a great name for themselves as scientific opticians by the design and introduction of lenses of distinctively original type and extremely fine quality, issued at remarkably low prices. The Aldis anastigmats of $f/6$ and $f/7.7$ aperture have attained a wide degree of popularity, and have permitted of purchasers of moderately priced camera sets obtaining the advantage of a lens of the anastigmatic type. For use with these lenses a further appreciated introduction of Messrs. Aldis has been their "Duo" and "Trio" lenses, the former an attachment increasing the focal length of the complete Aldis lens two times, and the latter effecting an increase in focus to the extent of one and a half times. The purchaser of these attachments thus obtains at a moderate expenditure a long-focus lens of $f/12$ or $f/9$ aperture in addition to his $f/6$ objective. A further series of the Aldis lenses has been issued of aperture $f/5.6$, whilst within the past few years the makers have achieved a further success by their introduction of a series of $f/4.5$ objectives of remarkably fine optical quality in the way of flatness of field and extreme defining power. The latest of this high-speed series is the No. 18 of $8\frac{1}{2}$ -in. focal length for half-plate work, sold at the very moderate price of £6 15s. Another special lens designed and made in the Aldis factory is a series of short focus anastigmats for direct photo-micrography without a microscope. These lenses, costing only about £1 10s., allow of direct enlargements being made upon a very considerable scale of magnification by means of the simplest type of apparatus, whether working by direct or transmitted light. Address: Sare Hole Road, Sparkhill, Birmingham.

Beck, R. and J. Limited.—For years past Messrs. Beck have been large manufacturers of inexpensive photographic objectives of the R.R. type. The $f/8$ "Beck Symmetrical" is a lens which has been fitted in enormous quantities to hand and stand cameras, the price of which would not allow of the provision of the more costly anastigmat; and excellent service these R.R. lenses have rendered and

BRITISH RESOURCES.—PHOTOGRAPHIC LENSES—*continued*.

still continue to render to those whose purse is limited. During the past few years, however, Messrs. Beck have originated several series of anastigmat lenses of a distinctive type, their characteristic feature being the use of single glasses of shallow curves, yielding a flat anastigmatic field and working at apertures from $f/3.5$ to $f/11$. The "Isostigmat" was the first of these lenses, and is issued at a price which can be judged from that of the 6 in. $f/5.8$ instrument, namely, £3 2s 6d. An objective in the series covering a wider angle at an aperture of $f/6.3$ is sold (of the same focal length) at £4 4s. In a succeeding construction, the "Neostigmat," Messrs. Beck introduced a lens somewhat similar to the "Isostigmat," but with the important difference that the single components can be used as lenses of longer focus. Thus in the case of the 4½-in. "Neostigmat" working at $f/6$ one gets also a 7¼ in. lens of $f/9$ aperture and a 9½ in. lens working at $f/12$. The "Neostigmat" can be obtained of full aperture either $f/6$ or $f/7.7$, the price of a 6 in. objective of $f/6$ aperture being £2 15s. or £2 2s. 6d. of $f/7.7$ aperture, prices which it will be seen are little more than was often paid for lenses of the older R.R. type. It should be mentioned that the shorter focal lengths of the "Neostigmat" lens are made of the aperture of $f/3.5$ for cinematograph cameras and projection lanterns. Messrs. Beck are also makers of telephoto attachments, of which optical appliance they have a number of models, among them the "Multiflex," a single complete instrument giving a range of from 6 to 36 ins. focal length in the quarter or 5 by 4 size, and from 7½ to 45 ins. in the half plate size. Address: 68, Cornhill, London, E.C.

Dallmeyer, J. H., Limited. Although the name has a German sound the house of Dallmeyer is and always has been since its establishment in 1860 entirely British. Its present managing director, Mr. C. F. Ian-Davis, is now an officer in the Naval Air Service. Whilst Dallmeyer lenses of the past have played a notable part in the development of photographic optics, we are concerned here chiefly with the instruments of the present day. Notable among these is the Dallmeyer Patent Portrait Lens issued in a series of three apertures, $f/3$, $f/4$, and $f/6$. It is scarcely too much to say that no portrait lens has had or continues to have such universal vogue as those of Dallmeyer, particularly the B lenses of $f/3$ aperture. Of late years the lens has been still further improved by the provision of a soft-focus adjustment, readily operated by rotating part of the lens mount and yielding a pleasing degree of soft definition the extent of which can be repeated by the use of a scale fitted to the objective. In anastigmats Messrs. Dallmeyer are represented by the "Stigmatic," "Carfac," and "Serrac" series of lenses, the latter an anastigmat of $f/4.5$ aperture.

A further notable speciality is the manufacture of lenses of the telephoto type. So far as concerns practical work it may be said that the late Mr. T. R. Dallmeyer was the discoverer of the telephoto lens. The original method (use of a negative attachment)

BRITISH RESOURCES.—PHOTOGRAPHIC LENSES—*continued.*

has largely been displaced by his later invention of the "Adon" telephoto lens, an instrument made in a number of models by Messrs. Dallmeyer, and providing the photographer with a telephoto objective giving either any required magnification or, alternatively, one fixed degree of magnification chosen by the maker in the design of the instrument. We would add to this list the series of large-aperture lenses especially designed and made for cinematograph work, and therefore of specially large aperture. In one instance, the No. 2 "Kinematograph" lens, it has been found possible to attain an aperture of $f/1.9$. Address: Church End Works, Willesden, London, N.W.

Davidson, F., and Co. Messrs. Davidson are makers of a unique optical instrument called by them the "Micro-Telescope," the distinctive features of which we have described in previous "Almanacs." Here it may be said that the instrument may be used, first, as an ordinary microscope; secondly, as a photo-micrographic outfit for use at high and low magnifications, and also for obtaining highly magnified photographs of objects several feet from the camera. It can also be employed as a telephoto camera. A further modification of the instrument (the "Super-Microscope") allows of photo-micrographs being made at extraordinarily high magnifications. Address: 29, Great Portland Street, London, W.

Ross, Ltd.—As manufacturers of optical instruments Messrs. Ross's business was established in 1830, that is to say nine years before the invention of photography. Within a very short period of the processes of Daguerre and Fox Talbot coming into public notice Messrs. Ross began to manufacture objectives adapted for the taking of Daguerreotypes and for the exposure of the comparatively insensitive papers of Fox Talbot. Since that time their introductions in the way of photographic lenses have regularly marked improved facilities for photographers. They were, in fact, the first firm to place upon the market a lens of the anastigmat type, the "Concentric," an instrument which in common with the other early anastigmats is now almost forgotten among the later types of construction of large aperture. Among these the Ross "Xpree" of $f/4.5$ aperture takes a leading, if not the leading, place as an anastigmat of the highest degree of perfection suitable for all classes of photography. It is issued in focal lengths from 4½ ins. to 21 ins., all of the full $f/4.5$ aperture. Another notable and recent Ross objective is the "Combinable," an anastigmat of aperture $f/5.5$ to $f/6.3$, each separate component of which is a fully corrected anastigmat also, and can be used at an aperture of $f/11$. The "Combinable" is made in a series of focal lengths from 4 to 21 ins., and the user who chooses any given focus for the complete lens has the option in almost every instance of equal or different foci in the components. Thus, the 6-in. lens may consist of two 10½-in. components, or a 9½ and 11½ ins.

Still another comparatively new type of objective, and one which

BRITISH RESOURCES PHOTOGRAPHIC LENSES—continued

has received the highest praise from experts as the Ross "Telecentric" a fixed focus telephoto lens of the great aperture of $f/5.4$ or $f/6.8$ and affording a focal length which roughly is twice the camera extension required. For use on reflex cameras, folding cameras, and single extension and other apparatus the "Telecentric" has made a place for itself, for although of the telephoto type its definition is of the critical quality of a high grade anastigmat. The focal lengths run from 9 to 17 ins.

We should also mention the Ross series of "Homocentric" anastigmats the Ross portrait lenses of focus from 8 $\frac{1}{2}$ to 16 ins., and the wide angle lenses of anastigmat type specially designed for architectural work, copying, etc. The focal lengths of these latter are from 3 $\frac{1}{2}$ to 12 $\frac{1}{2}$ ins. The requirements of process workers have been catered for in the $f/8$ Process Homocentric lens, which is made in focal lengths from 12 to 24 ins. and for use with which Messrs. Ross manufacture optically worked three colour filters as well as reversing prisms. A special series of lenses of from 2 to 6 ins. focus and of aperture from $f/3.5$ to $f/4.5$ are made for cinematograph cameras also another series in focal lengths of 4 to 7 ins. of aperture $f/3$ for cinematograph projection. Address: 3, North Side, Clapham Common, London S.W.

Taylor Taylor and Hobson Ltd. Perhaps one of the most eloquent testimonials which can be given to the Cooke lenses made by Messrs. Taylor Taylor and Hobson in their Leicester factory is that the type of construction remains practically the same as that adopted for the first Cooke lenses on these instruments being placed upon the market some twenty years ago. While other makers have introduced all kinds of variations in the optical design of objectives the simple type of three single glasses has with some minor exceptions been retained in the manufacture of what is now a very full series of Cooke lenses of apertures ranging from $f/3.5$ to $f/8$. Extreme fineness of definition, fitness of field and brilliancy of image have always characterised the Cooke lenses, whilst mechanically the work of the makers is unexcelled. A special feature of the Cooke objectives is the improved form of flanged screw with abrupt thread, which makes the removal or replacement of a lens an extremely rapid operation without thereby sacrificing anything in the way of security of attachment. The most popular perhaps of the Cooke lenses is the series III of $f/6.5$ aperture lenses which are admirable for all descriptions of photography with a hand or stand-camera. More rapid series are IV of $f/5.6$ aperture and II of $f/4.5$, whilst specially for cinematography in the shorter focal lengths and for portraiture in the lenses of longer focus the series IIA is made of $f/3.5$ aperture. In addition to this latter series, two other types of Cooke portrait lens are made where extreme rapidity is not a matter of such vital consideration. These are the series II of $f/4.5$ aperture and series VI of $f/5.6$ aperture. In the series II any degree of softness of definition is secured by revolving

BRITISH RESOURCES.—PHOTOGRAPHIC LENSES—*continued*.

the front of the mount, whilst in the series VI. the softening movement is made by means of cords and pulleys operated from the back of the camera so that the actual effect may be watched upon the focussing screen. Although of somewhat higher f number than many portrait lenses, it should be stated that the Cooke objective, by reason of its simple type of construction (and consequent thinness of glasses) has a rapidity in excess of that of its aperture number. Many of the more recent types of anastigmat lens contain many reflecting surfaces or involve the use of glass components of considerable thickness—factors which do certainly reduce rapidity, though to an extent which so far has not been made the subject of accurate measurement. The facts, however, require to be kept in mind in giving adequate appreciation to the simple form of construction adopted in the Cooke objective. Address: Stoughton Street Works, Leicester.

Watson, W., and Sons, Limited.—As scientific opticians, Messrs Watson have special claim to notice by their design of a large aperture anastigmat doublet lens of the cemented type; that is to say, one having only four reflecting surfaces. This lens, the "Holostigmat," is issued in several models, No. 1a having an aperture of $f/4.6$, which high speed is maintained throughout the series of focal lengths ranging from $4\frac{1}{2}$ to $10\frac{1}{2}$ ins. The lens is of the symmetrical type, a further valuable feature of it being the large aperture ($f/8.5$) at which the single components may be used. In the series I. the aperture is $f/6.1$ and the separate components similarly utilisable at an aperture of $f/11.5$. In this series a wide choice is afforded between symmetrical and unsymmetrical construction for a given focal length, the worker having the opportunity of choosing an objective which provides him with two or with three different foci according to the type selected. In other words, the purchaser of a "Holostigmat" secures in every instance not only the focal length he chooses as best suited to his requirements, but also a focus of about double this length, and, in the case of the unsymmetrical lenses, a further focal length about $1\frac{1}{2}$ times that of the complete lens. The combination of this facility with the large aperture of $f/4.5$ provided with the 1a "Holostigmats" renders these latter notable among photographic objectives. The "Holostigmat" construction is likewise applied in a process lens of aperture of $f/9.5$, and in a wide-angle lens working at $f/11$ and covering an angle of about 110° . Address: 313, High Holborn, London, W.C.

MOUNTS AND APPLIANCES.

Barton's.—Of late years Messrs. Barton's have come into the very front rank as producers of the most artistic style of mounts for both professional and amateur use. For the former their productions include the very choicest descriptions of folder mount, in which the harmonious combination of the texture and colour of the outer cover with those of the inner board which receives the print evidences taste of the most refined kind. Mounts, unfortunately, are the most difficult of things to describe adequately in cold print, but we can say this of Messrs. Barton's: that a photographer, no matter how exacting he may be as regards the mounts upon which he places his work, must be altogether unreasonable if Messrs. Barton's fail in giving him something to his liking. In slip-in mounts and calendars, more especially for the amateur trade, Messrs. Barton's styles are perhaps somewhat more conventional but none the less artistic. The firm is also the maker of a numerous series of albums, among them the "Simplico," a loose-leaf album made up of choice flexible mounting boards, any one of which is very quickly removed from the album, which externally does not differ in appearance from one of the ordinary type. It is made in a series of sizes from 6½ by 5 in. to 12 by 9½ in. Another speciality is the "Quadro" frame-edging, a metal substitute for paper passe-partout binding. The "Quadro" metal binding is made in four art dull colours, jet black, art grey, art brown, and art green, in lengths from 3½ to 15 inches. The effect is altogether admirable and an immense improvement on paper binding, which is often not of the neatest at the start and frequently soon shows signs of wear. The "Quadro" edging allows a photographer to offer his customer something which is a permanent frame and yet very inexpensive. Address: Cosway Works, Finch Road, Handsworth, Birmingham.

Bean and Holliday.—All descriptions of mounts, for amateur and professional use, are made by this old established Leeds firm. The styles include single and folder mounts adapted for the use of studios of all grades. The factory is well equipped for turning out any given description of mount upon the largest scale. Address: Holbeck New Mills, Holbeck Lane, Leeds.

Butcher, W., and Sons, Ltd.—For many years past Messrs. Butcher have been makers of all descriptions of mount in their own London factory, and at the present time their productions cover an exceedingly wide range, represented by a catalogue which runs to 160 pages. The manufactures include a very large series of the finest folder mounts for the professional photographer, in addition to many choice styles of flexible and vellum mounts down to the cheaper varieties of stiff paste-down mounts in all patterns and sizes. One special series is that of mounts for enlarged portraits; another, mounts for amateurs' exhibition prints of comparatively large size.

When we come to the many patterns of slip-in mount for the amateur worker the variety is still greater. Many of these are of a very choice description, whilst others are designed to meet the

BRITISH RESOURCES.—MOUNTS AND APPLIANCES—*continued.*

requirements of a cheap class of trade. The production extends also to all descriptions of album, among them a recent introduction in the shape of a "War Records" album, in which the cover paper forming a series of cut outs on each page is the subject of "thumb-nail" sketch decoration of a kind appropriate to the present time. Address: Camera House, Farringdon Avenue, London, E.C.

Fordham and Co., Ltd.—For twenty-five years Messrs. Fordham have been manufacturers of mounts and mounting boards upon a very large scale for both home and export trade. Many of their productions are placed on the market by trade houses, to whom are reserved particular styles or designs. Messrs. Fordham's business is one which lays itself out specially for the supply of mounts in tens or scores of thousands: they do not attempt to cater for the photographer whose orders may run only into a few gross of a given style, but in portrait mounts of all descriptions they are extremely competent to deal with sufficiently large orders. Their productions cover all descriptions of single and folder mounts, perhaps chiefly those which are suitable for studios doing a fairly high-class business at popular prices. They are also large producers of albums and calendars. Styles change so constantly that for the past year or two Messrs. Fordham have not issued a catalogue, but those in the position to order in sufficient quantity can obtain an idea of the firm's great resources from inspection of a set of selected specimens. Address: Victoria Works, Walthamstow, E.

Marion and Co., Ltd.—As the result of more than fifty years' experience in the making of photographic mounts Messrs. Marion naturally occupy a leading position in the supply of these essential materials. Their business in this branch, as in that of others, lies more particularly among professional photographers, the varieties of mounts covering the requirements of all classes of business, from those of the cheap midget and postcard photographer to the exacting demands of the ultra-fashionable studio. We have on many occasions had the pleasure of examining examples of the latest Marion productions in high-class mounts and have invariably had to admire the taste and resourcefulness of the firm in originating new designs and styles specially adapted to the kind of portrait in fashion at the time. The latest mount catalogue of Messrs. Marion consists of forty closely printed pages briefly describing the many modern styles at present made.

A comparatively new branch of manufacture with Messrs. Marion is that of frames, not the cheap description of compo moulding which German makers have foisted upon a long-suffering British public, but choice designs in frames, large and small, of a kind which makes it easy for the professional photographer to supply his customers also with frames for the portraits which they buy from him. Many of these frames are of the inlaid or liberator pattern (in wood) and designed for the two-fold use of hanging upon a wall or standing upon a table. A number of

BRITISH RESOURCES.—MOUNTS AND APPLIANCES—continued.

specially pleasing styles are those in which two or three frames are hinged together, whilst an altogether new series is the "Magna," an all-metal frame of untarnishable gilt which, though inexpensive, is not tawdry. A feature of this frame is that the strut back allows of the frame being stood either upright or oblong. Although perhaps the majority of these new styles are in frames of comparatively small size, yet the larger frames for presentation portraits, oil paintings, etc., are also included amongst Messrs. Marion's productions. Address: 3, Soho Square, London, W.

Fry, Ernest Bickersteth, Limited.—Among makers of mounting materials we should mention also a firm which has specialised in the materials for the masking and mounting of lantern-slides and for the mounting of prints in the passe-partout style. The adhesive binding strips made by the firm are double-coated on a thin, tough paper with a special cement, and are in every way of first-rate quality, easily applied, sticking permanently, and unaffected by the heat of the lantern. Similar suitability for their purpose is shown by the firm's masks and discs for lantern-slides which are most accurately cut, thin, and free from pinholes. Messrs. Fry issue a neat binding machine of a roller pattern facilitating the application of the adhesive strip. Other specialties of theirs for lantern-slide work include opaque and transparent notice plates, for announcements in white lettering on an opaque ground or in ordinary ink on a clear ground, as also graduated tinting glasses for giving a spectrum-like effect to such announcements on the screen. Their passe-partout binding, issued in twelve art shades, has all the good qualities of the lantern binding, whilst a further mounting speciality is a series of print edge mounting strips for securing prints to either cardboard or paper mounts by the edges only without cockling or curling. The firm's list (giving only the trade prices) is one which deals most fully with lantern-slide accessories of all descriptions. Address: 110, Pratt Street, Great College Street, London, N.W.

Adhesive Dry-Mounting Co., Limited.—As the original promoters of the French invention of dry-mounting by means of an adhesive tissue, the Adhesive Dry-Mounting Company have been pioneers in popularising the method and in demonstrating the refinements of which it is capable in all classes of photographic work, amateur as well as professional. Their tissue, a standard product, is now marketed as "Adomco." They are also the introducers of a series of "border tints," consisting of thin art mounting papers, coated on one side with the shellac adhesive, and thus facilitating the production of the most elegant border effects by the dry-mounting method. Further than that, the Company has itself specialised in the supply of mounts specially suited to the process and distinguished by their beauty of surface and shade. The Company's specimen books of border tints and of mounting boards show the extremely fine range which they offer in delicate shades of green, grey, and brown, embodying as fine a selection as can be desired for

BRITISH RESOURCES.—MOUNTS AND APPLIANCES—*continued.*

the artistic mounting of every description of photographic print. The Company are likewise suppliers of a series of the hot presses required for the dry-mounting process. These are of the design found by the firm to be the most effective for regular work as the result of their own large experience as dry-mounters for the publishing trade. They include models ranging from one for amateur use to the larger presses for the trade printer and enlarger. Address : 27 28, Fetter Lane, London, E.C.

Adherent Tissue Co., Ltd.—Another maker of adhesive tissue whose product has achieved wide popularity is the Adherent Tissue Company, who likewise manufacture a wide range of adhesive tint papers in a series of art shades. Proprietary rights in the manufacture or use of shellac tissue for mounting was the subject of patent litigation some few years ago when, rightly or wrongly, the judgment was that the patent rights in the original French invention could not be sustained. The Adherent Tissue Company, the defendant in the case, has greatly extended its scope since that time, and justifiably claims excellent qualities as regards keeping and permanent adhesion for its tissue. It is also a supplier of a series of mounting presses, including one of an automatic power type for dry-mounting work upon the most extensive scale. Address : 117a, Fore Street, Upper Edmonton, London, N.

Hyde and Co. Dating practically from the introduction of the dry-mounting process, Messrs. Hyde have been manufacturers of the necessary hot presses. These they now make in nearly a dozen different models, from the smallest for amateur use to those of the largest size for the purposes of the trade printer, presses in the series being adapted for the use of either gas or electric current as the source of heat. Address : 30, Duke Street, Chester.

FRAMES AND MOULDINGS.

From the mount to the frame is a natural transition, on which account we have, in the case of one or two of the firms mentioned in the preceding section, touched upon their resources as manufacturers also of frames. The frame industry, in fact, is one which is considerably in touch with photographic portrait studios, with enlargers and with photographic dealers who include frames among the goods which they sell. On the other hand, it extends itself also to a very large degree among print-sellers and professional framers. Thus it would be impossible for us to deal adequately in the space at our disposal here with the manufacturers in the United Kingdom of frames and mouldings in general, a class of makers who have keenly experienced German competition, particularly in the cheaper descriptions of moulding. We should, however, refer to makers of frames and mouldings who have specially considered the requirements of photographers in their production of frames, large and small, of wood and metal, and of

a kind particularly adapted for the proper display of photographic prints and enlargements. Of these we would mention Messrs. Bennett and Jennison, Ltd., Julian Street Works, Grimsby; Birmingham Moulding Warehouse, 48, Great Hampton Street, Birmingham; J. Epstein and Co., Rupert Street, Bristol; F. W. Forbes, 15, Bowling Green Lane, Farringdon Road, London, E.C.; Frost and Reed, Ltd., 8, Clare Street, Bristol; Maron and Co., Ltd., Soho Square, London, W.; O. Sichel and Co., 52, Bantull Row, London, E.C.; The Tress Company, 4, Rathbone Place, Oxford Street, London, W.; G. Vendon, 24, Stoke Newington Road, London, N.; and Matthias Walts and Co., Ltd., The Art Works, Moseley Village, Birmingham.

PHOTOGRAPHIC CHEMICALS.

Burroughs Wellcome and Co.—The "tabloid" photographic preparations of Messrs. Burroughs Wellcome have been familiar to photographic workers in every part of the globe, and it is hardly necessary to refer here to their consistently high quality and efficiency for their particular purposes. At the present time the "tabloid" developer "Rytol" comes into special prominence from the fact that it was originated in England, and is a developer of universal application to plates, films, and all descriptions of development papers. The tabloid "Chromium Intensifier" is another preparation which has found extensive use, as have also the sepia, blue, and green toners, supplied in tabloid form, of which exceedingly effective use has been made by leading workers in the toning of prints and lantern slides. The full list of tabloid chemicals is beyond the scope of our space. The chief photographic preparations are the subject of a manual obtainable free from Messrs. Burroughs Wellcome under the title "Photography in Five Lessons." Address: Snow Hill Buildings, London, E.C.

Bramwell, E., and Son, Ltd.—A firm of chemical manufacturers whose products in the way of bulk sulphite of soda and hypo have been bought in the photographic trade for many years. Address: Navigation Chemical Works, St. Helen's, Lancashire.

Johnson and Sons, Manufacturing Chemists, Ltd.—More familiarly known as "Johnsons," this old established firm has long taken a leading place in the manufacture of chemicals in bulk for photographic use as well as in the production of bottled chemicals and the manufacture of compressed and packet photographic preparations. Since the outbreak of war Messrs. Johnsons have put down very extensive plant for the manufacture of amidol in order to meet

BRITISH RESOURCES.—PHOTOGRAPHIC CHEMICALS - continued.

the extra demand caused by stoppage of Continental supplies. Amidol-Johnsons is now being supplied not only to the English market, but to all parts of the world. It is an exceedingly pure form of this popular developer, yielding the finest results in the development of bromide and gaslight papers, plates, and films. Another specialty of Messrs. Johnsons is their Azol single solution developer, which within a few years has gained very wide popularity among all classes of users for plates, papers, and films. The makers issue exceedingly useful tables for time development for all makes of plates and films which dispense with any calculation in making allowance for the temperature of the developer. Azol is marketed in 3 oz., 8 oz., 16 oz., bottles; also in 25 c.c. to 500 c.c. bottles. A further all-British product of the firm is their magnesium flash-powder of proved safety and efficiency. The powder is supplied in two portions (mixed at the time of use), which make it safe for transport and storage, and allow of its retaining its quality.

Without attempting to refer to the full series of chemical preparations of Messrs. Johnsons a word may be said on their collodion (for the wet-plate process) on their brand of iron perchloride for half-tone etching and on their series of varnishes for gelatine plates, retouching and spotting media, and dead-black for wood or metal. Address: 23, Cross Street, Finsbury, London, E.C.

Johnson, Matthey and Co., Ltd.—As melters and assayers to the Bank of England, Messrs. Johnson. Matthey occupy a leading place among firms supplying the precious metals and their compounds. Their chief supplies in the photographic trade are silver nitrate, gold chloride, and potassium chloroplatinite, compounds which for many years past they have manufactured of high purity. It is not too much to say that the firm's initials "J. M. and Co." or their trade mark (a crossed hammer and pick) is a guarantee of the full strength of the compounds which bear this brand. Each 15-grain tube of gold chloride is guaranteed to contain a minimum $7\frac{1}{2}$ grains of gold; that of chloroplatinite, 7 grains of platinum metal, and the same standard of purity may be relied upon in the larger bulks, from 30 grains to 1 ounce, in which these gold and platinum chemicals are supplied. Address: Hatton Garden, London, E.C.

Mawson and Swan, Ltd.—A number of chemical preparations are specialties of this old-established chemical firm, among them a quick-drying backing sold as "Oppozalo," a retouching medium, varnishes for negatives, ground-glass varnish, mounting paste, and enamel-collodion, in addition to the Mawson collodion for regular negative and positive work by the wet-collodion process to which we have alluded in a previous chapter. Address: Mosley Street, Newcastle-on-Tyne.

May and Baker, Ltd.—Chemicals for all branches of photographic work, including those for photo-engravers and ferro-prussiate

BRITISH RESOURCES.—PHOTOGRAPHIC CHEMICALS—*continued.*

printers are manufactured by this old-established firm, with the exception only of the modern synthetic developing agents of the metal type and of salts of silver and gold. Their products include hydroquinone, iron citrate and oxalate, as well as carbonate, sulphite, and hyposulphite of soda. Address: Battersea, London, S.W.

Vanguard Manufacturing Co.—For nearly twenty years we have had the opportunity of constant experience of the chemical preparations for photographic work made by the Vanguard Company, the active director and proprietor of which, Mr. W. Ethelbert Henry, is himself a skilled practical worker, and, years ago, an accomplished lecturer and demonstrator of photographic processes. In all that time it is only right that we should say that to our knowledge the Vanguard Company has never put out any inferior goods; on the contrary, its manufactures have constantly been characterised by their high standard of working efficiency. The firm's productions include solutions for developing, toning, etc., as also a variety of other preparations in the introduction of which the Company has largely led the way. One very useful specialty is "Autogene," a solution for use in both the intensification and reduction of negatives, and, in conjunction with the firm's "Sepiogene," serving also for the sepia toning of bromides and lantern slides. Both preparations are free from scheduled poisons.

More recent introductions are "Bango," a rapid glazing solution which most effectually solves the difficulties of glass polishing or sticking prints in glazing by the stripping method; "Photopake," a spotting preparation for use also in blocking out, writing and lettering, etc., on negatives, and one so universally used that its name has almost become synonymous with blocking-out preparations in general. Another valuable specialty is "Billdup," a colourless varnish for the film or glass-side of negatives on which pencil work may be done as easily as upon paper, pinholes spotted out, and all kinds of retouching work enormously facilitated. Sold also in non-flammable form specially for abroad. Still another Vanguard product is "Frictol," an abrasive reducer for negatives, and a time-saving substitute for the cruder metal-polishing pastes hitherto employed. It is of general use in removing surface markings from negatives or prints. The foregoing are only a few of the many reliable Vanguard manufactures. Others which we might mention are the "Extra Black" for renovation of leather, "Spotopake" (for spotting prints), "Vitrivene" (acid-proof varnish), "Halogene" (a caramel plate-backing), "Nirogene" (a dead black varnish for wood or metal), and the "Vanguard" retouching medium. Address: Maidenhead.

MATERIALS AND PLANT FOR THE PHOTOGRAPHIC INDUSTRY.

Chance Bros. and Co., Ltd.—Although at the present time the resources of Messrs. Chance Bros.' works at Birmingham and Glasgow in the manufacture of optical glass are devoted to Government service, it is fitting that reference should be made in this review to the considerable progress which has been made by them of late years in the manufacture of the special descriptions of glass necessary for the construction of modern photographic lenses and other optical instruments. Messrs. Chance's list specifies the physical constants of the glasses manufactured by them, whilst the result of further research work now being prosecuted will, it is hoped, permit of the full requirements of opticians being satisfied in the near future. Address: Glass Works, near Birmingham.

Pirie, Alex. and Son, Ltd.—On the outbreak of war one of the chief concerns felt by makers of emulsion printing papers was the maintenance of the supply of the raw paper or stock upon which the emulsion is coated, the bulk of this supply coming from factories in Alsace and Germany. Messrs. Pirie, in their Aberdeen paper mills, had for some years previously been engaged on experiments in the manufacture of raw paper and card for photographic emulsions. These efforts were quickly given more extended and practical shape by alterations and additions to existing plant by means of which raw and baryta coated paper and card suitable for bromide and gas-light emulsions have already been manufactured upon a considerable scale and supplied to houses at home and abroad. This, however, is only a temporary measure, for Messrs. Pirie have designed a new factory for baryta-coating which will undoubtedly be the largest and best equipped of its kind in this country. It is hoped that it will be in full working order early in 1916. From its favourable position on the river Don, some four miles from Aberdeen, it is well situated for a branch of manufacture in which extreme cleanliness and freedom from dust and dirt at every stage is of paramount importance. The factory, in addition to the ordinary coating, drying, and finishing-rooms for baryta papers will include a complete plant for emulsion making and coating (for testing and experimental purposes) as well as experimental laboratories for research work. Hopes have so often been entertained—only to be disappointed—of English paper makers taking up this branch of business that it is a source of considerable satisfaction to record Messrs. Pirie's enterprise. Address: Union Works, Aberdeen.

Munro, R. W.—All descriptions of automatic machinery for the photographic plate and paper trade are made by Mr. Munro. They include plant for emulsion shredding, washing, cleaning and coating machinery for plates, in addition to machines for coating, reeling, and cutting paper. The grinding of splitters and guillotine knives is a specialty of the firm. Address: 103 to 149, Cornwall Road, South Tottenham, London, N.

Masson, Scott, and Co., Limited.—The building of machinery for all descriptions of photographic manufacture is likewise a special branch of the business of Messrs. Masson, Scott, who are makers of coating machines for baryta paper, emulsion-coating machines for all descriptions of photographic materials, as well as festooning, drying, perforating, and cutting machinery used in the photographic trade. Address: Coronation Wharf, Townmead Road, Fulham, London, S.W.

Scott, N. L. and Co.—Another field in which the English engineer will doubtless oust the German constructor is in the equipment for the manufacture of photographic plates and papers. Messrs. Scott make machines for the production of the whole range of sensitive materials, the head of the firm, Mr. Newton L. Scott, having occupied the position of chief engineer to Messrs. Kodak, Limited, for five years. The firm's machines include automatic paper-coating, drying, and reeling apparatus, emulsion shredding presses, paper-cutting machines, apparatus for the coating and washing of glass plates, and the full plant for the manufacture of celluloid film. The firm's catalogue illustrates the standard patterns of these machines, and evidences the great competence of Messrs. Scott in constructing and erecting plant to makers' individual requirements. Address: 3, Pancras Lane, London, E.C.

Graber, Ellis.—Requirements of photographic publishers of postcards, as also those of trade printing and other firms engaged in the production of photographic prints and postcards in large editions, have been specially catered for by Mr. Graber in the design of a series of machines most efficiently equipping this class of business. The Graber machines automatically expose sensitive bromide or gaslight card or paper from the reel, at the same time printing on the face-side any required type matter. The machine also automatically cuts off the sensitive band into lengths of 7, 14, or 28 postcards, as required for developing by hand, or it may be supplied without this feature where the roll is developed and fixed by the rotary process, for which operation also Messrs. Graber supply the necessary plant. The machine is adapted for use with either gas or electric light, and is provided with efficient means for masking the negative, setting the time of exposure, and quickly changing the negative during a run. The machines represent very high-grade engineering work, and have been adopted by many leading firms. Address: 16, Newton Road, Tunbridge Wells.

OTHER FIRMS OF THE ENTENTE AND THE UNITED STATES.

Aussedat et Cie.—Manufacturers in Great Britain of bromide paper and postcards have had cause during the present war to appreciate the resources of this French firm of raw-paper makers of Annecy. Despite the difficulties created by the national crisis in France, the Papeteries Aussedat have been able to keep their mills in constant working with the exception of the first three weeks following mobilisation in France. Fortunately their establishment has been outside the war zone, and transport via Bordeaux has been practicable. The firm has thus been able to render considerable service to English makers and further to cement the commercial relations between this country and France. Sole British and Export Agents: H. J. Brown and Co., 408, Mansion House Chambers, Queen Victoria Street, London, E.C.

Gevaert and Co.—As is well known to photographers and the trade generally throughout the world, the factories of this progressive Belgian firm are in Antwerp; having reminded our readers of which, there is hardly any need for us further to refer to the difficulties Messrs. Gevaert have had to face. For many months now they have been unable to supply any of their well-known papers, and we are quite confident that their very wide circle of customers will be extending their sympathies to them in the difficult position in which they are placed. Included in the list of Gevaert products are their series of bromide, P.O.P., and gaslight papers; in addition to collodio-chloride, gravure, and collodion self-toning papers which had become popular amongst discriminating workers. In addition to these products, we must not omit reference to the excellent Gevaert platinum papers, including the very artistic and quite unique line offered to the high-class worker in their Japanese tissue, this being platinum coating on a genuine hand-made Japanese material.

Negative and positive film for cinematograph work is also among the manufactures of Messrs. Gevaert, whose products, it should be added, are marketed in Great Britain and the colonies by the English registered Company Messrs. Gevaert, Limited, established some six or seven years ago. Address: 60, Wilson Street, Finsbury, London, E.C.

Grieshaber Frères et Cie.—For many years MM. Grieshaber have been leading makers in France of both plates and papers, in regard to which products they have deservedly enjoyed a great reputation. Their plates, it should be added, are specially offered upon the English market under the name "Parisian." Sole agent for Great Britain, Mr. Reginald E. Carter, 39, St. James's Street, Piccadilly, London, S.W.

Lumière and Joula.—Although in common with other manufacturers in France operations have necessarily been disturbed from the moment of mobilisation, nevertheless it is fitting that we should

make mention here of the distinctive products of MM. Lumière in the shape of the Autochrome plates and of the series of ordinary Lumière plates for negative work, among which should be signalled the high-speed "Violet Label" plates. Plates for transparency work and roll-film in the form of spools or packs are likewise among MM. Lumière's normal manufactures, together with papers of gas-light, bromide, and print-out descriptions. The firm likewise manufacture many chemical preparations in the way of developers, fixers, intensifiers, reducers, and toners, a large number of which have been placed upon the market as the outcome of investigations made by MM. Lumière in their own laboratories. The distribution of Lumière materials in the United Kingdom and the British Colonies is in the hands of the sole agent, Mr. Thomas K. Grant, 89, Great Russell Street, London, W.C.

Richard, Jules.—Perhaps no camera has evoked such universal admiration for its mechanical excellence and beauty of design for its special purpose than the "Verascope" of M. Jules Richard. The "Verascope" has set a fashion in stereoscopic hand-cameras, and has created a standard size of plate, namely, one of 45 x 107 mm. The camera is made in a series of models ranging in price from about £8 10s. to £36. Its all metal construction has made for it a reputation for reliability in all descriptions of climatic conditions; whilst the sensitive material may be either plates or films, the former carried in a most convenient quick-acting changing-box and the latter in a roll-holder of the same mechanical excellence as the camera, and holding the film perfectly flat in the focal plane. A supplement to the "Verascope" is the "Taxiphote" automatic stereoscope, serving for the convenient viewing and storage of the stereoscopic glass transparencies, and adapted for use also as an enlarging or projection lantern. Mention should also be made of the larger model of the "Verascope" for 7 x 13 cm. plates, and of the "Glyphoscope," an inexpensive type of instrument for plate or film of 45 x 107 mm. size, and made so that it can be used also as a stereoscope for viewing the transparencies. Address: 27, New Bond Street, London, W.

Scory, J.—M. Scory occupies a long established position in the French photographic trade as a maker of glass, either optically worked or in the rough, for the production of light-filters and for various other optical purposes. Address: 162, Faubourg Saint-Martin, Paris, 10e, France.

Takiris Company.—The Société Anonyme Takiris is one of the French firms specialising in the manufacture of papers only. Their customary productions include a very wide range of bromide, gas-light, and P.O.P. papers and postcards, and though in common with other manufacturers in France their arrangements have been disturbed since the outbreak of war, they have been able to continue the supply of ordinary grades of these three materials. Address: Villeneuve-le-Roi, Seine-et-Oise, France.

AnSCO Company.—The history of this well-known American firm goes back to comparatively early days in the evolution of photography, the name "AnSCO" recalling its combination of the interests of the two firms of Anthony and Scovill, both of long association with the photographic trade in the United States. At the present day the AnSCO Company is engaged in the manufacture of all descriptions of photographic apparatus from hand-cameras of vest-pocket and larger sizes to the most elaborate instruments for the studio of the professional photographer and the photo-engraver. Moreover, they are manufacturers of roll film, their connection with this important product dating back to the original pioneer work of the late Hannibal Goodwin. British workers, perhaps, have appreciated the manufactures of the AnSCO Company chiefly in the shape of the series of "Cyko" (gaslight) papers, which speedily achieved very considerable popularity on their introduction upon the English market. The normal, soft, and vigorous grades of "Cyko," each issued in a series of admirable surfaces, are all distinguished by first-rate quality, and the same remark applies in an even more special degree to the slower "Professional" grade of "Cyko," characterised by the extreme richness and fine black tone of the prints and by the "natural" beauty of several of the surfaces in which it is issued. "Professional Cyko" has, in fact, attracted to itself numbers of critical professional users by whom it has been welcomed as a distinctively fine product. The London house of the AnSCO Company is AnSCO, Ltd., 143 to 149, Great Portland Street, London, W.

Eastman Kodak Co.—It can hardly be necessary to say much by way of information as to the world wide resources of the companies springing from the inventive and business genius of Mr. George Eastman; yet it would scarcely be fitting to omit mention of them in this review, since the English branch of the Eastman Company, Messrs. Kodak, Limited, is a large manufacturer in the United Kingdom, whilst Eastman products of all descriptions, both apparatus and materials, form a very large part of photographic trading in this country. The word "Kodak," marking the manufactures of the Kodak Company's, in its application to cameras, film, and development tanks, represents a combination of facilities which has created the world-wide vogue of amateur photography on the "daylight-all-the-way" system. The latest Kodak refinement is perhaps the autographic feature, by which the user can note on the film, at the time of exposure, any brief particulars of the subject.

In their factories at Harrow, Middlesex, Messrs. Kodak, Limited, manufacture plates and papers, among the former the Eastman and "Royal Standard" as well as the celebrated series of Wratten plates, the last-named as the outcome of the purchase of the old-established English business of Wratten and Wainwright, Limited, some few years ago. The Wratten panchromatic is a notable member of this series, which includes also other Wratten plates of the ordinary kind, with their long reputation for reten-

tion of their quality under the most trying climatic conditions. The papers include the well-known varieties of Kodak Bromide, "Valox," "Solio," and "Kodura," whilst at Harrow also are prepared the series of Kodak tested chemicals, issued after searching analytical tests of their purity.

Of Kodak film, in the form of daylight spools and film-packs and for cinematograph negative and positive work, there is even less occasion to write, since these products of the Eastman factories at Rochester, New York State, are household words wherever photography is practised. A later product is the Eastman Portrait Film, a flexible flat film for use in ordinary dark-slides, which by its lightness, emulsion quality, and non-halative properties has largely found favour with professional workers.

In like manner we might prolong this necessarily brief notice to many times its length without adequately referring to the Kodak series of cameras (Kodaks), of all sizes and patterns, for roll-film and (Premos) for film packs and plates, not to mention the reflex series of cameras, as well as cameras and other apparatus particularly for the professional photographer.

In all this great industry research in chemical and mechanical matters has played a great part, that in the former field having recently been greatly extended by the establishment of the Eastman Research Laboratory at Rochester, under the directorship of Dr. C. E. Kenneth Mees, assisted by a staff of scientific colleagues. The Laboratory publishes many papers describing its research work, whilst from it also has come the Kodachrome process of colour photography, yielding portrait colour-transparencies of remarkably fine quality. Address: Kodak House, Kingsway, London, W.C.

Makers of Photo-Materials and Booklets issued free by them.

In this list are included in addition to the names of actual makers, those also of some few sole or special agents, supplying goods under manufacturer's labels. The list does not attempt to include firms supplying unbranded photographic materials.

Plates (other than Lantern) and Films P.O.P., Bromide and Gaslight Papers Self-Toning Papers.

Austin Edwards
Cadett
Carter
Collins
Criterion
Elliott
Gem
Grant
Ilford
Imperial
Kodak
Leto
Marion
Mawson
Paget
Rajar
Wellington
Wratten

Anaco
Baryta
Cadett
Criterion
Elliott
Gem
Gevaert
Griffin
Grant
Ilford
Illingworth
Imperial
Kentmere
Kodak
Kosmos
Leto
Marion
Paget
Rajar
Takiris
Wellington

Criterion
Elliott
Griffin
Ilford
Illingworth
Imperial
Kentmere
Kodak
Leto
Paget
Rajar
Wellington

Platinum Papers

Gevaert
Ilford
Kodak
Platinotype Co

Lantern Plates

Cadett
Elliott
Gem
Grant
Griffin
Ilford
Imperial
Kodak
Leto
Marion
Mawson
Paget
Thomas
Wellington
Wratten

Collodio - Chloride Paper

Gevaert
Grant
Ilford
Kodak
Leto
Marion
Paget
Rajar

Carbon

Autotype Co
Elliott
Illingworth
Kentmere

Miscellaneous Printing Papers

Gevaert
Halden
Marion
Paget

BOOKLETS, ETC., ISSUED GRATUITOUSLY BY THE PHOTOGRAPHIC TRADE.

ADHESIVE DRY-MOUNTING CO. LTD.—All about Dry-mounting.

ALDIS BROS.—Child Portraiture.

ANSCO, LTD.—Professional Cyko Manual.

“ “ “ “ Cyko (gaslight) Printing for Amateurs.

AUTOTYPE CO.—First steps in Autotype Printing.

BURROUGHS WELLCOME & CO.—Photography in Five Lessons.

CRITERION, LTD.—The Plate Photographic.

“ “ “ “ Bromoil.

ELLIOTT & SONS, LTD.—Aids to Exposure, Development and Printing.

“ “ “ “ Printing and Enlarging by Carbon Process.

GEM DRY PLATE CO., LTD.—The Photographer and the Plate.

“ “ “ “ Gem X-Ray Plates.

GEVAERT, LTD.—Gevaert Platinum Paper and How to use It.

GRANT, THOS. K.—Instructions for use of Autochrome Plates, Lumière Plates, Films, Papers, and Chemicals.

GRIFFIN, JOHN J., & SONS, LTD.—Oil Pigment Printing.

“ “ “ “ Sketch Portraits and Border Printing.

ILFORD LTD.—Ilford Plates. (Exposure, Developing, Intensification, etc.)*

“ “ “ “ Every-Day Book of Common Failures Illustrated.*

“ “ “ “ Ilford Exposure Tables.*

“ “ “ “ Notes on Isochromatism.*

“ “ “ “ Printing on P.O.P. and Self-Toning Paper.*

“ “ “ “ Bromide and Gaslight Papers.*

“ “ “ “ Lantern Slides on Dry Plates.*

“ “ “ “ Ilford X-Ray Plates.*

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FORMULÆ FOR THE PRINCIPAL PHOTOGRAPHIC PROCESSES.

ORTHOCHROMATIC PROCESSES.

(Most of the formulæ in this section are those used in the three-colour and process department of the L.C.C. School of Photo-Engraving, Bolt Court, London, E.C., to the Principal of which—Mr. A. J. Bull, we are indebted for assistance in arranging them in the present form.—ED. B. J. A.)

Sensitisers for Gelatine Plates.

1.—For blue-green and green.

To sensitise up to wave-lengths, 5,500 A.U., a good dye is *acridine orange*, N.O. of the Leonhardt Farbwerke, Mülheim, Germany. It is used as directed below for green and yellow sensitising, except that ammonia must not be used.

The isocyanines mentioned below are also extremely good sensitisers for green, and are probably faster, but require suitably adjusted green filters when nothing beyond the green is required.

2.—For green and yellow, but not red.

To sensitise up to 5,900 A.U., *erythrosine* is still the best dye, though it leaves the plates somewhat insensitive to bluish green. The most suitable dye is that of Dr. Schuchardt, Goerlitz, or of Meister Lucius and Bruning, Hoechst, a/M.

One part of dye is dissolved in 1,000 parts of alcohol, and a bathing solution made as follows:—

Stock solution 1 : 1,000	100 parts
Water	400 parts
Ammonia (0.880)	5 parts

This is a 1 : 5,000 solution.

N.B.—Ammonia must not be used with *acridine orange*.

3.—*Green, yellow and red.*

To sensitise for all rays up to 6,200 to 6,400 A.U. the following are used:—

Orthochrome T, Pinaverdol, Pinachrome, or Homocol,
their order as red sensitisers being as above.

A stock solution is made containing 1 part of the dye in 1,000 parts alcohol. The bathing solution contains.—

Stock solution	2 parts
Water	100 parts

This is a 1 50,000 solution.

The stock solution will keep, but the weaker bath will not. A red light is used, until it is seen that the solution has covered the plates, after which the operation must be continued in total darkness.

4. *Extreme visible red*

To sensitise for the extreme visible red, *pinacyanol* should be used. The operations can be done in a weak green light, passing the part of the spectrum between 5,000 and 5,300. The dye solutions are prepared exactly as those of *Orthochrome T*, etc See above.

5.—*Panchromatic Plates*

Use a 1-50,000 solution of a mixture of *pinachrome* and *pinacyanol*, viz., 3 parts *pinachrome* stock solution, 2 parts *pinacyanol* stock solution; water, 250 parts.

6.—*Infra red.*

The best sensitiser for the infra red is *dicyanine*, which is prepared and used exactly as *pinacyanol*, except that the stock solution must not be added to the water until the very last moment, when everything is quite ready, and the plate can be immediately flowed with the solution, as the weak solution loses its sensitising power very quickly.

If ammonia is used with the cyanine sensitisers given in 3, 4, and 5, it must be quite pure, or fog will be produced. It is best to dispense with it, but if used the proportion is about 1 part per 100 of sensitising bath.

PRACTICAL NOTES ON BATHING.

The dye solution is prepared in a measure, the plates are dusted and laid in a flat porcelain dish, which is large enough to hold nearly twice the number of plates it is desired to sensitise at one time. These are put at one end of the dish, the dish is then tilted, and the dye solution poured into the other (empty) end, then the dish is tilted back, so that the dye solution sweeps over the plates in one even flow free from air bells. The dish is now gently rocked for three minutes, then the plates are removed and washed in a good stream of running water for at least another three minutes. Their sensitiveness and keeping quality will probably be somewhat greater if they are washed for ten minutes, but they will remain good for months, kept under proper conditions, after three minutes' thorough washing, if bathed according to the formulae given above.

The water tap should be fitted with one of the small anti-splash filters, the fine wire gauze in which retains any solid particles that may be in the water.

After washing, the plate should be well swabbed with a wad of cotton wool, and then placed in a drying cupboard. The quicker drying takes place the better, so that if a current of warmed, filtered air, free from fumes, can be sent through the cupboard it is an advantage, though the absence of this convenience need not deter anyone from sensitising plates. Drying can be hastened by placing a dish of dry calcium chloride or quicklime at the top of the cupboard.

Sensitisers for Collodion Emulsion.

FOR GREEN AND GREENISH YELLOW (Hubl).

Pinaverdol (1 500)	.. ..	1 oz.	40 c.c.s.
Collodion emulsion	.. ..	25 ozs.	1,000 c.c.s.

The sensitiveness extends from the orange to the violet.

PANCHROMATIC SENSITISERS (Hubl).

Pinaverdol (1 500)	.. ..	3 ozs.	30 c.c.s.
Ethyl violet (1 500)	.. ..	$\frac{1}{2}$ oz.	5 c.c.s.
Collodion emulsion	.. ..	100 ozs.	1,000 c.c.s.

Pinacyanol can be substituted for ethyl violet.

FOR RED SENSITISING

Pinacyanol (1 1,000)	.. ..	3 ozs.	3 c.c.s.
Collodion emulsion	.. ..	100 ozs.	100 c.c.s.

FOR BLUE AND (SLIGHTLY) BLUE GREEN SENSITIVENESS.

The following sensitiser increases the sensitiveness of the collodion ordinary work—

Canary II. (sat. sol.) (Reads Holliday, Huddersfield)	.. ..	1 oz.	10 c.c.s.
Emulsion	.. ..	10 ozs.	100 c.c.s.

The dyed emulsion keeps well, and in half-tone work gives a sharp clean dot, but its speed is not improved.

Safe-lights for Developing.

(Newton & Bull)

Yellow safe light for wet plates, bromide papers

		Per sq. cm.	Grs per sq in. (approx.)
Tartrazine	.. ..	1 mgm.	$\frac{1}{16}$
Or brilliant yellow	.. ..	0.5 mgm.	$\frac{1}{32}$
Or naphthol yellow	.. ..	1 mgm.	$\frac{1}{16}$
Or auramine	.. ..	2 mgm.	$\frac{1}{8}$

Red safe light for ordinary plates.

	Per sq. cm	Grs per sq. in. (approx)
Tartrazine	1 mgm	$\frac{1}{16}$
Rose bengal (or fast red)	0.5 mgm	$\frac{1}{32}$

Safe light for Ortho plates

The above screen is combined with one containing —

Methyl violet	0.5 mgm	$\frac{1}{32}$
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The red screen transmits light from the end of the visible red about λ 7,000 to λ 5,900 in the yellow. The methyl violet absorbs from λ 6,500 to λ 5,000, so that the only light passing the two is the extreme red of λ 7,000 to λ 6,500.

The dyes are dissolved in gelatine solution which in winter should be about 8 per cent in strength and about 10 per cent in summer. About 20 c.c.s. should be allowed for every 100 sq. cm. of glass, i.e., about 20 minims per sq. in. The dyes are added, most conveniently from stock solutions, in quantity to give the proportions stated above in the filters.

DEVELOPERS AND DEVELOPMENT.

In this section we give developers for plates, roll and cut films arranged in alphabetical order.

PREPARATION OF CHEMICALS IN COMMON USE

Soda sulphite should be in clear crystals. It should be kept well corked, otherwise the crystals become dull and powdery. Such sulphite must be rinsed for a few seconds, in a measure, with enough cold water to cover it, the water poured away and the crystals dried on a clean cloth and weighed out. Warm water, not hot or cold, is the best to use. The ordinary form of sulphite (to be used in all formulæ in this book unless otherwise directed) is the "cryst." The "anhydrous" is a stronger variety, 1 part of which is equivalent to about 2 parts of "cryst."

Potass metabisulphite should be in flattish crystals, with only a little powdery coating on them. Both dry and in solution it keeps much better than sulphite, and goes much further as a preservative. It should be well corked.

It must not be dissolved in hot water. Metabisulphite is an acid substance; every grain neutralising 1 grain of soda carbonate cryst., $\frac{1}{2}$ grain of caustic potash, $\frac{1}{4}$ grain caustic soda, or $\frac{1}{16}$ grain dry potass carbonate.

Soda carbonate cryst. is best purchased from a photographic dealer. Washing soda ("sal soda" in the U.S.) is a more or less impure

form. The salt loses water in the air, becoming thereby somewhat stronger, and should therefore be kept well corked.

Potass carbonate should be purchased 'dry' and be most securely corked, it absorbs moisture greedily, and if it has been kept for any time should be dried in the oven before weighing out.

Caustic potash. Purchase as best stick pure and keep well corked. Weigh out quickly and handle as little as possible, as it corrodes the skin.

Caustic soda resembles caustic potash and the same remarks apply.

Note.—In all formulæ the metric weights are not equivalents of the British items for item, but each formula gives a solution of the same composition.

The following are a few of the typical formulæ generally employed for development etc.

Amidol.

Dumidophenol.)

A normal developer consists of

Amidol	2 3 grs	4 5 7 grs
Sodium sulphite	25 grs	57 5 grs
Water to	1 oz	1 000 c c s.

The mixed developer will keep well in solution for about a week, or sometimes longer if it is made *not stronger* than given above. It must be made up with freshly dissolved sulphite as this salt does not keep well in solution for more than a few weeks. A sodium sulphite solution that has had added to it some potassium metabisulphite will, however, keep well for a very long period and by the addition of dry amidol a fresh developer can be rapidly prepared when required. Make the following stock neutralised sulphite solution—

NEUTRAL STOCK SULPHITE

Sodium sulphite	4 ozs	200 grs.
Potassium metabisulphite	$\frac{1}{2}$ oz	25 grs
Water to	20 ozs	1,000 c c s

It is best to boil this mixture after having dissolved the chemicals in moderately hot water. Boiling is not essential but it improves the keeping qualities of the solution.

DEVELOPER

Amidol	40 60 grs	2 3 grs	4 5 7 grs
Stock sulphite sol	4 ozs	100 minims	200 c c s
Water to	20 ozs	1 oz	1,000 c c s

Amidol is an excellent non staining developer, giving detail at first and density afterwards. Suitable for plates papers and lantern slides.

Azol.

The following are the instructions for the use of this single solution developer:—

For Plates and Films:—

Normal exposures:	Azol ..	20 mins.	$\frac{1}{2}$ oz.
	Water ..	to 1 oz.	to 6 ozs.
Under-exposures:	Azol ..	15 mins.	$\frac{1}{2}$ oz.
	Water ..	to 1 oz.	to 8 ozs.
Over-exposures:	Azol ..	30 mins.	$\frac{1}{2}$ oz.
	Water ..	to 1 oz.	to 4 ozs.

For stand development:—Azol, 1 oz.; water, 100 ozs.

For tank development:—Azol, $\frac{3}{4}$ oz.; water, 40 ozs. Time of development of films at 60 deg. F., 20 to 30 minutes. This solution may be used several times in succession.

For lantern slides and transparencies:—Azol, 25 mins.; potass. bromide 10%, 5 mins., water to 1 oz.

For bromide papers:—Azol, 15 mins.; water to 1 oz. A few drops of 10% solution potass. bromide may be added if the whites are grey.

For gaslight papers: Azol, 40 mins., water to 1 oz. Add a few drops of 10% solution of potass. bromide, sufficient to keep the whites clear.

Diamidophenol.

See Amidol.

Edinol.**ONE-SOLUTION.**

For soft portrait negatives.

Sodium sulphite ..	5 ozs.	250 gms.
Edinol ..	100 grs.	11 gms.
Sodium carbonate ..	2 ozs.	100 gms.
Water ..	20 ozs.	1,000 c.c.s.

For contrasty negatives.

Acetous sulphite (Bayer) ..	288 grs.	33 gms.
Sodium sulphite ..	4 ozs.	200 gms.
Edinol ..	100 grs.	11 gms.
Potassium carbonate ..	2 ozs.	100 gms.
Potassium bromide ..	50 grs.	55 gms.
Water ..	20 ozs.	1,000 c.c.s.

The ingredients should be dissolved strictly in the order given

Edinol tends to contrast when a carbonate is used: to softness when a caustic alkali is employed. A developer of the latter class contains, in one ounce, edinol, 2½ grs.; caustic soda, 1½ gr.; and sodium sulphite, 10 grs

Eikonogen.

A.—Sodium sulphite ..	2 ozs.	100 gms.
Eikonogen ..	$\frac{1}{2}$ oz.	25 gms.
Distilled water ..	20 ozs.	1,000 c.c.s.

B.—Potass. carbonate	1½ oz.	75 gms.
Distilled water	20 ozs.	1,000 c.c.s.

For use, mix equal volumes of A. and B.

ONE SOLUTION.

Sodium sulphite	2 ozs.	100 gms.
Sodium carbonate	1 oz.	50 gms.
Distilled water	20 ozs.	1,000 c.c.s.
Eikonogen	½ oz.	25 gms.

Eikonogen is a good developer for full detail without excessive density in the high lights.

Eikonogen-Hydroquinone.

A.—Hydroquinone	40 grs.	4.5 gms.
Eikonogen	120 grs.	14 gms.
Sodium sulphite	480 grs.	55 gms.
Citric acid	20 grs.	2.3 gms.
Water to	20 ozs.	1,000 c.c.s.
B —Potass. bromide	5 grs.	0.5 gms.
Sodium carbonate	60 grs.	7 gms.
Caustic potash	30 grs.	3.5 gms.
Water to	20 ozs.	1,000 c.c.s.

For use, mix in equal parts.

This developer is suitable for negatives, lantern plates, and bromide papers

Ferrous Oxalate.

This developer is rarely used now; it calls for greater exposure of the plate. But it is unique in the perfectly clear grey stainless negatives which it yields.

A.—Potass. oxalate (neutral), 5 ozs.; hot water, 20 ozs. Cool, and pour off clear liquid for use.

B.—Warm water, 20 ozs.; sulphuric acid, 30 minims; sulphate of iron, 5 ozs.

Mix 1 oz. of B. with 3 to 4 ozs. of A (pouring B into A, not vice versa).

A more powerful developer is made by dissolving commercial dry ferrous oxalate in boiling saturated solution of potassium oxalate. As much as will dissolve is stirred in, and the whole left to cool, after which the clear solution is poured off for use.

FOR TRANSPARENCIES ON GELATINO-CHLORIDE PLATES.

A.—Neutral oxalate of potash ..	2 ozs.	100 gms.
Ammonium chloride	40 grs.	4.5 gms.
Distilled water	20 ozs.	1,000 c.c.s.
B.—Sulphate of iron	4 drs.	34 gms.
Citric acid	2 drs.	17 gms.
Alum	2 drs.	17 gms.
Distilled water	16 ozs.	1,000 c.c.s.

For black tones, mix the above in equal volume.

HURTER AND DRIFFIELD'S STANDARD FERROUS OXALATE DEVELOPER.*(The Photographic Journal, 1898.)*

A.—Potassium oxalate	1 part
Water	4 parts
B.—Ferrous sulphate	1 part
Citric acid	0.01 part
Water	3 parts
C.—Potass. bromide	1 part
Water	100 parts

For use take A, 100 parts; B, 25 parts; C, 10 parts Development to be conducted at a temperature of 65 deg F.

The ferrous oxalate as compounded above contains in every 1,000 parts:—Potassium oxalate, 185 parts; ferrous sulphate, 68.5 parts; citric acid, 0.61 part; potassium bromide, 0.74 part.

Glycin.**ONE-SOLUTION (HÜBL).**

Boiling water	4 ozs.	1,000 c.c.s.
Sodium sulphite	2½ ozs.	625 gms.
When dissolved add --		
Glycin	1 oz.	250 gms.

And then in small quantities—

Potass. carbonate	5 ozs.	1,250 gms.
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This forms a thick cream, which must be well shaken and then diluted with water; for normal work, dilute 1 oz. with 12 or 15 ozs. of water; for very soft results with 30 ozs. of water.

ONE-SOLUTION.

Glycin	1 oz.	33 gms.
Sodium sulphite	2½ ozs.	83 gms.
Potass. carbonate	5 ozs.	166 gms.
Water to	30 ozs	1,000 c.c.s.

For normal exposures dilute with an equal bulk of water.

Glycin is a slow-acting developer which keeps for a very long time and yields negatives perfectly free from stain. It is the best reagent for "Stand Development" (which see).

Hydroquinone.

Made up with soda carbonate (as per the first formula below) hydroquinone is a rather slow-acting developer. The caustic-soda formul is quicker, but easily gives excessive density and contrast; it is best suited for line drawings or subjects where full contrast is required.

ONE-SOLUTION

Hydroquinone	100 grs.	11.5 gms.
Sodium sulphite	1½ oz.	75 gms.
Sodium carbonate	3 ozs.	150 gms.
Water to	20 ozs.	1,000 c.c.s.

May be diluted with an equal volume of water.

This formula is not so quick in action as the next one, but there is less tendency for the great density in the high-lights which is easily produced in cases of under-exposure. In all cases the temperature of the hydroquinone developer should not be allowed to fall below 60 deg., or the solution becomes inert.

TWO SOLUTION (CAUSTIC SODA).

A.—Hydroquinone	160 grs.	18 gms.
Sodium sulphite	3 ozs.	100 gms.
Citric acid	60 grs.	7 gms.
Potass. bromide	40 grs.	4.5 gms.
Water to	20 ozs.	1,000 c.c.s.
B.—Caustic soda (stick)	160 grs.	18 gms.
Water to	20 ozs.	1,000 c.c.s.

For use:—A, 1 oz.; B, 1 oz.; water, 2 ozs.

ONE-SOLUTION (WITH FORMALINE).

Hydroquinone	130 grs.	15 gms.
Sodium sulphite	6 ozs.	300 gms.
Formaline	3 drs.	20 c.c.s.
Water to	20 ozs.	1,000 c.c.s.

A slow developer, giving great clearness in the shadows and plenty of density in high-lights, and specially suitable for line-subjects.

Imogen Sulphite.

A.—Imogen sulphite	1 oz.	83 gms.
Distilled water (warm)	12 ozs.	1,000 c.c.s.
B.—Sodium carbonate	1 oz.	500 gms.
Water	2 ozs.	1,000 c.c.s.

For correct exposure, A, 2 ozs.; B, 2 ozs.; water, 4 ozs. For under-exposure or soft negatives, A, 1 oz.; B, 3 ozs.; water, 4 ozs. For over-exposure, A, 2 ozs.; B, 2 ozs.; water, 3 ozs.; potassium bromide, 40 per cent. solution, 1 oz.

Kachin.

A.—Kachin	160 grs.	9 gms.
Sodium sulphite	2½ ozs.	62.5 gms.
Water to	20 ozs. (fl.)	500 c.c.s.
B.—Sodium carbonate	2 ozs.	50 gms.
Water to	20 ozs. (fl.)	500 c.c.s.

For use take equal parts of A and B. More diluted developer gives softer results. The solutions should be used at a temperature of 60 to 65 deg. F. Assuming exposure to have been correct, with this

solution the image commences to appear in about one minute, and when full density is required development is completed in from four to six minutes. Softer effects are obtained in from three to four minutes. No restrainer is really necessary, but in the case of over-exposure the use of a few drops of 5 per cent. solution of ordinary borax is recommended.

Kachin is almost free from staining properties and is excellent in its clean development of stale plates, on which it does not produce the common iridescent markings.

Metol.

ONE SOLUTION (HALL)

Metol	..	..	150 grs.	17 gms.
Sodium sulphite	..	..	2½ ozs.	125 gms.
Sodium carbonate	..	..	3½ ozs.	175 gms.
Potass. bromide	..	..	16 grs.	18 gms.
Water	..	..	20 ozs.	1,000 c.c.s.

In making up all metol developers dissolve the metol first, then the sulphite, and then the other chemicals, using warm but not hot water.

For portraits, take stock solution, 1 oz., water, 1 oz. For landscapes, stock solution, 1 oz., water, 2 ozs.

Metol gives delicate negative with great detail and little density unless development is greatly prolonged. See 'Factorial Development.'

TWO SOLUTION (HALL)

A.—Metol	..	..	150 grs.	17 gms.
Sodium sulphite	..	..	2½ ozs.	125 gms.
Water to	..	..	20 ozs.	1,000 c.c.s.
B. Sodium carbonate	..	..	3½ ozs.	175 gms.
Potass. bromide	..	..	16 grs.	2 gms.
Water	..	..	20 ozs.	1,000 c.c.s.

For portraits, A, 1 oz., B, 1 oz. For landscapes, A, 1 oz., B, 1 oz. water 1 oz.

ONE SOLUTION (ANDRIEN)

Metol	..	..	160 grs.	18 gms.
Sodium sulphite	..	..	3½ ozs.	175 gms.
Potass. carbonate	..	..	1½ ozs.	87.5 gms.
Potass. bromide	..	..	22 grs.	2.5 gms.
Water	..	..	20 ozs.	1,000 c.c.s.

For use, take 1 part of developer to 3 of water.

TWO SOLUTION (ANDRIEN)

A.—Metol	..	..	160 grs.	18 gms.
Sodium sulphite	..	..	3½ ozs.	175 gms.
Water	..	..	20 ozs.	1,000 c.c.s.
B.—Sodium carbonate	..	..	3½ ozs.	175 gms.
Water	..	..	60 ozs.	3,000 c.c.s.

One part of A is mixed with 3 parts of B, potass. bromide being added as required for prevention of fogging.

Metol (and other developers) has a poisoning effect on the skin of many persons, causing painful sores and irritation.

The following ointment has a very beneficial effect in such cases:—

Ichthylol	..	..	..	10 grs.
Lanoline	..	..	..	40 grs.
Boric acid	..	..	..	40 grs.
Vaseline	..	..	..	30 grs.

Apply two or three times a day, and rub in well before retiring for the night.

Metol-Hydroquinone.

ONE SOLUTION.

Metol	..	..	..	35 grs.	4 grs.
Sodium sulphite	..	..	..	2 ozs.	100 grs.
Hydroquinone	..	..	..	50 grs.	5.7 grs.
Sodium carbonate	..	..	..	1½ oz.	75 grs.
Water to	..	..	..	20 ozs.	1,000 c.c.s.

This is mixed with an equal volume of water at the time of use.

Dissolve the chemicals in metol hydroquinone developers, in the order given in the formulae.

TWO SOLUTION

A.—Metol	..	..	..	40 grs.	4.5 grs.
Sodium sulphite	..	..	..	120 grs.	14 grs.
Hydroquinone	..	..	..	50 grs.	5.7 grs.
Potass. bromide	..	..	..	15 grs.	1.7 gm.
Water to	..	..	..	20 ozs.	1,000 c.c.s.
B. Sodium carbonate	..	..	..	½ oz.	25 grs.
Water	..	..	..	20 ozs.	1,000 c.c.s.

Mix in equal parts.

In cold weather it is best to increase the quantity of metol to, say, 60 grs. (6.8 grs.) and reduce the hydroquinone to, say, 30 grs. (3.4 grs.).

Ortol.

ORTOL-SODA

A.—Ortol	..	..	..	140 grs.	16 grs.
Potass. metabisulphite	..	..	..	70 grs.	8 grs.
Water, cold	..	..	..	20 ozs.	1,000 c.c.s.
B.—Sodium carbonate	..	..	..	2½ ozs.	125 grs.
Sodium sulphite	..	..	..	3½ ozs.	175 grs.
Potass. bromide	..	..	..	10 to 20 grs.	1.1 to 2.3 grs.
Water	..	..	..	20 ozs.	1,000 c.c.s.

100 minims of 1 in 2 hypo solution may be added to solution A, and is said to brighten the shadows, but this addition is of doubtful value.

In cold weather the potassium bromide may be left out.

For quick development take 1 part of A and 1 part of B. For slow and soft development take 1 part of A, 1 part of B, and 1 part water.

Ortol solution should not be made up with sodium sulphite, otherwise red stain may be caused, nor should ammonia be used with it. In other respects it closely resembles pyro.

Paramidophenol.**ONE SOLUTION**

Potassium metabisulphite	6 ozs	500 grms
Distilled water (bottled)	20 " "	1 000 ccs
Paramidophenol	2 oz	100 grms

Dissolve in the above order and add gradually -

Catstic soda or potash q s.

so dissolve the precipitate first formed

For use dilute 1 with from 10-30 times of water

Paramidophenol is unstable and keep well in single solution owing probably to its pre-oxidative action on sodium sulphite

TWO MIXTURES

A	Paramidophenol (hydrated)	200 gr	25 grms
	Potassium metabisulphite	100 gr	115 grms
	Distilled water	70 c	1 000 ccs
B	Sodium sulphite	1½	62.5 gr
	Potassium carbonate	1½	62.5 grms
	Distilled water	0	1 000 ccs

For use mix 1 of A with 1 of B

Pyro-Acetone

A	Pyro	1	100 grms
	Sodium albit	4 ozs	400 grms
	Distilled water	3 " "	1 000 ccs

Potassium metabisulphite is added and neutralised and there should be no alkalinity left and

Normal development is

Alkali (pyro + albit is 8 ccs)	40 minims	80 ccs
Acetone	40 minims	80 ccs
Water	1 c	1 000 ccs

and is made in 1 c in 40 minims of A solution adding 40 minims of acetone and making up to 1

Pyro-Ammonia.**10 SOLUTIONS**

A	Pyro	1	100 grms
	Potassium sulph	1	100 grms
	Water (min)	9	1 000 ccs
B	Potassium bromide	1	100 grms
	Distilled water	9 " "	1 000 ccs
C	Liquid ammonia (0.80)	10 (fl)	100 ccs
	Distilled water	9 ozs	1 000 ccs

*Or Soda sulphite 4 ozs 400 grms

To make a normal developer, take A, 20 minims; B, 10 minims; C, 30 minims; water to 1 oz.; or if no bromide is used, A, 20 minims; C, 10 minims; to water, 1 oz., or in metric measures, A, 2 c.c.s.; B, 1 c.c.; C, 3 c.c.s.; water to 50 c.c.s.

Pyro-Soda Developer.

(The "B.J." Formula)

Make up two solutions according to the following formulae—

A.--Neutral sulphite solution	.. 14 ozs.	700 c.c.s.
Pyro (sublimed or cryst)	.. 160 grs.	18 gms.
Water to make	.. 20 ozs.	1,000 c.c.s.
B. Soda carbonate	.. 4 ozs.	200 gms.
Water to make	.. 20 ozs.	1,000 c.c.s.

Take A, 1 part; B, 1 part water, 2 parts.

The following is the neutral sulphite solution

Soda sulphite cryst.	.. 4 ozs.	200 gms.
Potass. metabisulphite	.. $\frac{1}{2}$ oz.	25 gms.
Water to	.. 20 ozs.	1,000 c.c.s.

This solution should be boiled if possible, as the keeping quality of the solution is thereby improved.

This developer will produce negatives free from pyro stain, and 4 to 6 minutes' development at normal temperature with full exposure will yield soft negatives full of detail and well suited to enlarging. The advantages of the developer are its cleanliness, and the extraordinary keeping qualities of the A solution.

When stronger negatives are required, the developer can be made up by taking equal parts of A, of B, and of water, or equal parts of A and B alone can be used, this giving a developer containing 4 grains pyro to the ounce.

The mixed solution can be used for several plates in succession if a little extra time is given for development in each case.

It will be noticed that in making up A solution 14 parts of sulphite solution must be added to 6 parts of water, which is equivalent to adding 7 parts to 3. If less sulphite solution is taken, a slightly quicker developer is obtained, but the result will show pyro stain in the lights.

It is as well to use freshly made neutral sulphite solution for making up the A solution if absolute freedom from stain is desired.

The Hurter and Driffield standard pyro soda developer for plate-speed testing is.—

Pyro	.. .. .	8 parts.
Sodium carbonate	.. .. .	40 parts.
Sodium sulphite	.. .. .	40 parts.
Water to	.. .. .	1,000 parts.

Pyro-Caustic Soda.

(VALENTA.)

A.—Pyro	..	..	..	220 grs.	25 gms.
Soda sulphite	..	..	..	3½ ozs.	162.5 gms.
Water to	..	..	..	20 ozs.	1,000 c.c.s.
B.—Caustic potash	..	..	..	100 grs.	11.5 gms.
or					
Caustic soda	..	..	..	70 grs.	8.5 gms.
Water to	..	..	..	20 ozs.	1,000 c.c.s.

Take A, 1 oz.; B, 1 oz.; water, 1 oz.

The above is a quick-acting and cheap developer, resembling metol in its characteristics.

Pyro-Metol.

A.—Pyro	..	..	..	80 grs.	9.2 gms.
Metol	..	..	..	70 grs.	8 gms.
Potass. metabisulphite	..	..	..	180 grs.	20 gms.
Potass. bromide	..	..	..	50 grs.	3.5 gms.
Water to	..	..	..	20 ozs.	1,000 c.c.s.
B.—Soda carbonate	..	..	..	3 ozs.	150 gms.
Water to	..	..	..	20 ozs.	1,000 c.c.s.

For normal exposures, use equal parts. For under-exposures, increase the proportion of B and add water.

Pyro-metol is a developer which gives both detail and density quickly. The negatives are of slightly greenish-black colour, of good printing quality. An excellent developer for hand-camera exposures.

Pyrocatechin.

TWO-SOLUTION.

A.—Pyrocatechin	..	..	..	175 grs.	20 gms.
Sodium sulphite	..	..	..	1½ oz.	75 gms.
Water	..	..	..	20 ozs.	1,000 c.c.s.
B.—Potass. carbonate	..	..	..	2½ ozs.	125 gms.
Water	..	..	..	20 ozs.	1,000 c.c.s.

Equal parts are mixed together.

ONE-SOLUTION.

Sodium sulphite	..	..	..	5 ozs.	250 gms.
Water	..	..	..	20 ozs.	1,000 c.c.s.
Caustic soda	..	..	..	260 to 300 grs.	30 to 34.5 gms.
Pyrocatechin	..	..	..	400 grs.	46 gms.

The chemicals are dissolved in this order, and the stock solution kept well corked. It is diluted with 20 times its volume of water for use.

Rodinal.

Rodinal is a concentrated liquid preparation of para-amido-phenol

For general work, development of negatives:—Rodinal, 1 oz. water, 25 ozs. A stronger solution, *e.g.* Rodinal, 1 oz.; water, 10 oz. can be used to give density in a shorter time.

For over-exposures it is convenient to keep the following stock solution:—

Rodinal	..	..	..	1 oz.	30 c.c.s.
Potass. bromide	..	..	..	150 grs.	10 grms.
Water	..	..	..	1 oz.	30 c.c.s.

And add a few drops to the 1:30 rodinal developer in cases of over-exposure.

For under-exposures:—Rodinal, 1 oz. : water, 30, 40, or 80 ozs.

Stand Development.

Glycin is a very suitable developer for this purpose, and the following directions are given by Hubl for the use of the formula (given on another page) for a concentrated solution.

Normal developer:—Stock sol., 1 oz.; water, 80 to 90 ozs.; potass. bromide, 10 per cent sol., 80 minims.

In this solution a properly exposed plate should make its appearance in 15 or 20 minutes, and obtain full density in several hours.

For under-exposures:—Stock sol., 1 oz.; caustic soda sol. (10%), 1 oz.; water, 50 oz., warmed to 75 deg. F.

For over-exposures:—Stock sol., 1 oz.; potass. bromide, 10% sol. 1 oz.; water, 25 ozs.

Factorial Development.

The total time of development (found by trial to give a certain amount of contrast) divided by the time in which the image first appears is the "factor" of a developer.

The following "Watkins' factors" are abstracted from the instructions from the "Watkins' dark room clock and factoria calculator":—

SUGGESTED FACTORS.				Grs. pyro to oz. to oz. tor.		
	Grs. pyro to oz.	Factor.		1	$\frac{1}{2}$	9
Pyro-soda without bromide {	1	18	Pyro-soda with bromide {	2	$\frac{1}{2}$	5
	2	12		3	$\frac{1}{2}$	4 $\frac{1}{2}$
	3	10		4	1	4
	4	8		8	2	3 $\frac{1}{2}$
	5	6 $\frac{1}{2}$				

Pyro-acetone—about double the above figures.

	Factor.		Factor.
Adurol (Schering or Hauff)	5	Imogen sulphite	6
Amidol (2 grs. per oz.)	18	Imperial pyro-soda	4 $\frac{1}{2}$
Diamidophenol	60	Imperial Standard (pyro-metol)	9
Diogen	12	Kachin	10
Edinol	20	Kodak powders	18
Eikonogen	9	Metol	30
Glycin (carb. soda)	8	Metol-hydroquinone	14
Glycin (carb. potass.)	12	Ortol	10
Hydroquinone (min. bromide)	5	Pyrocatechin	10
Hydroquinone (max. bromide)	4 $\frac{1}{2}$	Quinomet	30
Ilford pyro-soda (maximum pyro)	4 $\frac{1}{2}$	Rodinal	40
Ilford pyro-soda (minimum pyro)	5 $\frac{1}{2}$		

Note.—High-factor developers (e.g., metol and rodinal), owing to the long time which is needed for density, tend to softness. Short-factor developers (e.g., hydroquinone and strong pyro-soda) tend to hardness, as they quickly build up density after the image appears.

Where a factor divides evenly into 60, the product is called a divisor, and will greatly facilitate calculating the total time of development. Thus aduol has a divisor of 12 (60 divided by 5), and if the time of appearance in seconds is divided by 12 the result is the number of minutes to develop.

PYRO-SODA DEVELOPERS.

With and without bromide.

	Factor.		Factor
Austin-Edwards (with B)	5	Marion (with B)	4½
Barnet (with B)	5½	Mawson (no B)	10
Cadett (no B)	5	Paget (no B)	11
Kodak (no B)	12	Thomas (with B)	5
Edwards (with B)	4	Wratten (no B)	11
Premier (with B)	4½	Wellington (normal)	11
Gem (with B)	4	Wellington (studio)	15

Combined Development and Fixing.

Although there is not much to be said for simultaneous development and fixing on practical grounds, the following formula may be given as one of the best for the purpose.

A. - Kachin	150 grs.	17 grs.
Sodium sulphite	3 ozs.	150 grs.
Water to	20 ozs.	1,000 c.c.s.
B. - Caustic soda	160 grs.	18 grs.
Water to	20 ozs.	1,000 c.c.s.
C. - Hypo	1 oz.	560 grs.
Water to	2 ozs.	1,000 c.c.s.

Take:—A, 160 minims; B, 24 minims; C, 20 minims; water to 1 oz., or, A, 32 c.c.s.; B, 5 c.c.s.; C, 4 c.c.s.; water to 100 c.c.s.

Restrainers.

Potassium bromide in 10 per cent. solution is the most common restrainer. The dose is from one half-grain (5 minims) per ounce of developer.

Ammonium citrate solution has the advantage that after it has been added to the developer density can be obtained without further fogging, though the development of detail is prevented. An average dose with the pyro-ammonium developer is 6 to 10 grains per ounce (60 to 100 minims of solution made by adding ammonia, about 250 minims, to 1 ounce of citric acid dissolved in a little water until neutral, and diluting the whole to 10 ounces).

Potassium borotartarate—10 to 30 minims of a 10 per cent. solution restrain with most developers.

Sodium bicarbonate acts as a restrainer, particularly with amidol developer.

FIXING, & HYPO ELIMINATORS.

The Hypo Fixing Bath.

In making up the fixing bath cold water should not be used. the hypo greatly chills the water as it dissolves, and hinders the process. There is no harm in using even very hot water if the bath is cold before use.

The average strength of hypo for fixing negatives is 4 ozs. per 20 ozs. It should not be less, but may be more -5, 6 or 8 ozs.

A convenient method of keeping hypo is to dissolve each pound in about a pint of water (hot), cool and make up to 32 ozs. in all. Every 2 ozs. of this stock solution equals 1 oz hypo. It is used as follows to make up baths of various strength --

Hypo, required per 20 ozs of fixing bath.	Mix. of stock solution,	Water	
8 ozs. ..	16	with 4	1 c, stock, 4, water, 1.
6 ozs. .	12	with 8	1 c, stock, 3, water, 2
5 ozs. ..	10	with 10	1 c, equal parts.
4 ozs. ..	8	with 12	1 c., stock, 2; water, 3.
3 ozs. ..	6	with 14	1 c, stock, 3, water, 7.
2 ozs. .	4	with 16	1 c, stock, 1; water, 4.

In fixing plates, observe three golden rules -

1 - Let plates remain in fixer as long again as it takes for the white emulsion to dissolve away

2 - Always rinse fingers under tap or in a dish of water after touching hypo, not simply wipe on a towel.

3 - Avoid letting hypo droppings dry up on table or floor. If hypo solution drops or is splashed or spilt about the dark room, mop it up with a floor cloth and leave all clean.

Acid Fixing Baths.

Hypo	4 to 6 ozs.	200 to 300 gms.
Potass. metabisulphite ..	$\frac{1}{2}$ oz.	25 gms
Water	20 ozs.	1,000 c.c.s.

The metabisulphite should be added only when the hypo solution is cool or tepid not when it is hot.

This is the best formula we know for an acid fixing bath for plates or papers. It keeps clear and stainless to the last, and does not throw down sulphur with use.

The following is a cheaper bath. -

Hypo solution (1.5)	50 ozs.	1,000 c.c.s.
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To which add a mixture of -

Tartaric acid solution (1:2) ..	1 $\frac{1}{2}$ oz.	30 c.c.s.
Sodium sulphite solution, (1.4)	3 $\frac{1}{2}$ ozs.	70 c.c.s.

Alum-Hypo Fixing Bath.

Alum (saturated solution)	..	20 ozs.	1 000 c c s.
Sodium sulphite (saturated solution)	.. .. .	4 7 0/4	200 300 c c s
Hypo-solution (1 5)	..	20 28 0/4	1,000 1,250 c c s

Chrome Alum and Hypo Fixing Bath.

Add—			
Strong sulphuric acid	.. .. .	2 dr (fl)	10 c c s
Water	.. .. .	2 c c s	80 c c s
to—			
Sodium sulphite	..	2 oz	80 grs.
Water	..	6 0 4	240 c c s.
And pour the mixture into			
Hypo	.. .. .	16 0/4	700 grms
Water	.. .. .	48 c c s	2 000 c c s.
Finally add to the above mixture			
Chrome alum	..	1 oz	40 grms
Water	.. .. .	8 ozs	300 c c s.

Removing Hypo by Washing.

In washing negatives in running water or frequent change over 90 per cent. of the hypo is cleared away in less than ten minutes. To remove the remainder, by a washer or hand method it is essential to drain off *all* the water in which the negative has soaked. The best washers are those which alternately empty and refill, and the same principle should be followed when washing in dishes. If this is done, there is no need to wash negatives longer than an hour at the outside.

Hypo eliminators are chemicals which convert the hypo into some other substance, but as it is not certain into what this chemical method of removing hypo is not so reliable as removal by washing. But we give three formulae.

Hypo-Eliminators.**PERMANGANATE.**

Wash the negative for one minute under the tap, and transfer to a shallow dish containing water with enough potash permanganate in it to turn it pink. Remove the negative as soon as the colour goes (which will be in a second or two if hypo is present), and keep on treating in the very weak permanganate baths until the colour is not discharged. The water itself will destroy the permanganate colour, but not quickly as hypo does. A very cheap and satisfactory process which allows of a negative being ready for drying within three minutes of fixation.

PERSULPHATE.

Ammonium persulphate	..	2½ grs.	6 grms
Carbonate of soda	..	5 grs	12 grms.
Water	.. .. .	1 oz.	1,000 c c s.

PERCARBONATE.

Potassium percarbonate	2½ grs.	6 gms
Water	1 oz.	1,000 c.c.s

Rapid Drying of Negatives.

Method I — Rinse from the hypo bath, place in 1. 50 formaline for ten minutes, wash by pouring nearly boiling water six times over the negative and dry by heat. To get rid of the relief which is produced by this process the negative is rubbed with a piece of wash-leather moistened with alcohol.

Method II — After washing in the usual way or using a hypo-eliminator, lay a piece of old fine cambric on the negative and firmly pass a roller squeegee over it. The negative, with much of the water thus removed, will dry in a few minutes in a moderately warm place.

Method III — Soak in two successive baths of methylated spirit and place in a current of air. The present commercial spirit, owing to the mineral naphtha in it, causes a whitish scum on the surface of the film, and is not favourable to clean work.

Method IV — Electric hot blow. By means of a blower of the kind used by huddlers and capable of giving a temperature of from 68 to 125 °F., within from ½ to 6 minutes, according to the distance of the blower from the rack of negatives—3 ft. to 1 ft.

HARDENING AND CLEARING SOLUTIONS.

As a general rule, there is no need to use a bath of alum, frilling or softening of the films of plates is seldom met with—that is, in temperate latitude. When it does occur, it is most usually the result of baths (developing, fixing, etc.) being of very different strength or at different temperatures.

If a plate should show signs of frilling in the developer, it should be rinsed for an instant and placed in one of the hardening baths given below, then washed for ten minutes before fixing. This is better than hardening after fixing.

Hardening Baths.

Formaline	1 oz. fluid	50 c.c.s
Water	10 to 20 ozs	500 1,000 c.c.s
Alum	1 oz	50 gms.
Water	20 ozs.	1,000 c.c.s.
Chrome alum	1 oz	50 gms
Water	20 ozs	1,000 c.c.s.

Whichever bath is used, allow it to act for 15 or 20 minutes.

In making up the chrome alum bath, use cold or warm, not hot water.

Clearing Solutions.

ACID ALUM.

Alum	2 ozs.	200 gms.
Citric acid	1 oz.	100 gms.
Water	10 ozs.	1,000 c.c.s.

Wash well after fixing, and immerse the negative in the above. This bath is also useful for removing white scum from negatives developed with ferrous oxalate if rubbed on with cotton wool.

CHROME ALUM.

Chrome alum	$\frac{1}{2}$ oz.	25 gms.
Hydrochloric acid	$\frac{1}{2}$ oz.	25 c.c.s.
or		
Citric acid	1 oz.	50 gms.
Water	20 ozs.	1,000 c.c.s.

We prefer this latter bath for the final treatment of negatives, and for obtaining a clean smooth film.

THIOCARBAMIDE.

Thiocarbamide	90 grs.	10 gms.
Citric acid	90 grs.	10 gms.
Water	20 ozs.	1,000 c.c.s.

SODIUM HYPOCHLORITE.

(Eau de Javelle.)

This bath need only be resorted to in cases of severe stain, particularly on old negatives.

Bleaching powder	1 oz.	30 gms.
Sodium carbonate	$1\frac{1}{2}$ oz.	45 gms.

Shake up the bleaching powder with a solution of the carbonate in a little water (6 ozs. or 180 c.c.s.), and filter. Extract the residue with plain water, and again filter. The filtrate (solution of sodium hypochlorite) forms an active stain remover. It can be acidified with oxalic acid, and then discharges yellow stain still more vigorously, but with risk to the silver image.

N.B.—In either state (alkaline or acid) the solution has a strong softening action on gelatine. Plates should not be left to soak longer than necessary—which should be 10 to 15 minutes as a rule.

REMOVING SILVER STAINS.

Most silver stains (due to dampness of paper or negative while the two are in contact) will readily yield to the following simple treatment first suggested by Mr. Harold Baker:—

Rub the dry negative with Globe metal polish (or other similar abrading preparation) for a minute or two. This is done by applying the polishing paste on a tuft of cotton wool. Then place negative in very strong hypo solution. Here the stain disappears: the time may be minutes or hours according to the depth and age of the stain.

In very severe cases the following method may be necessary —

Soak the negative in—

A.—Potass. iodide	..	..	..	200 grs.	45 grms.
Water	..	..	..	10 ozs.	1,000 c.c.s.

and after washing transfer to—

B.—Potass. cyanide	..	..	..	300 grs.	70 grms.
Water	..	..	..	10 ozs.	1,000 c.c.s.

In which rub the stained part of the film with a pledget of cotton wool.

If the stain does not yield to this treatment a solution of iodine (in potass. iodide) may be used in place of solution A.

NEGATIVE INTENSIFIERS.

Negatives which are too thin (and as a rule yield flat prints) may be greatly improved by intensification.

If the negative is thin through under-exposure, that is, has not attained good density even on long development, the best intensifier is the uranium. For this, as for most intensifiers, the plate should be both thoroughly fixed and washed—one is as important as the other.

If the plate is simply under-developed—clear and bright, but thin—the chromium or the mercury and ferrous oxalate intensifier (applied more than once if necessary) or the Wollington silver intensifier is very suitable. If the plate is over-exposed, thin but veiled and flat, the mercury and ammonia intensifier is a good remedy; or it may be well first to reduce carefully with Farmer's reducer, and then (after a second thorough wash) to intensify with chromium, mercury and ferrous oxalate, Wollington, or, if plate is very flat, with Monckhoven's or the mercury and ammonia formula. The copper and lead intensifiers give great density, and are suited only for negatives of line drawings, etc., in which great general opacity and, at the same time, great clearness of the lines are required.

Mercury Intensification.

The negative is bleached in the following saturated solution of mercury bichloride:—

Mercury bichloride (corrosive sublimate)	..	..	..	1 oz.	62 grms.
Hot water	..	..	..	16 ozs.	1,000 c.c.s.

After cooling this solution and pouring off from the white feathery crystals thrown down, add—

Hydrochloric acid..	30 minims	4 c.c.s.
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After *well washing*, the bleached negative is blackened in one or other of the following:—

A.—Ammonia (0 880)	20 drops	20 drops
Water	1 oz.	30 c.c.s.

Gives great intensification and good black colour.

B.—Soda sulphite, 10 per cent. solution, made slightly acid with citric acid. Very slightly strengthens a negative.

C.—An alkaline developer, such as pyro-soda, pyro-ammonia, hydro-quinone. Gives about double the intensification of B.

D.—Schlippe's salt	200-400 grs.	20-40 gms.
Water	20 ozs.	1,000 c.c.s.

This solution must be made fresh, and gives great intensification.

E.—Ferrous oxalate developer, made as directed under "Developers." This process can be repeated as many times as desired, and gives absolutely permanent results: it deals evenly throughout with the tones in the negative.

Monckhoven's.

A.—Bromide of potassium	10 grs.	23 gms.
Bichloride of mercury	10 grs.	23 gms.
Water	1 oz.	1,000 c.c.s.
B.—Pure cyanide of potassium	10 grs.	23 gms.
Nitrate of silver	10 grs.	23 gms.
Water	1 oz.	1,000 c.c.s.

The silver and cyanide are dissolved in separate lots of water, and the former added to the latter until a permanent precipitate is produced. The mixture is allowed to stand 15 minutes, and, after filtering, forms Solution B.

Place the negative in A till it is white, then rinse and transfer it to Solution B. If the intensification has been carried too far, it may be reduced by treatment with a weak solution of hyposulphite of soda.

Mercuric Iodide.

Water	20 ozs.	1,000 c.c.s.
Sodium sulphite	4 ozs.	200 gms.
Mercuric iodide	90 grs	10 gms

The sulphite must be dissolved first. The solution keeps well in the dark.

This is a very convenient intensifier, as plates need only be rinsed for a few minutes in water on coming out of the hypo bath to be ready for intensification.

When intensified they are simply washed for a few minutes; the negative is then liable to yellow in time, but if plate is placed for a few minutes in any non-staining developer the results are quite permanent.

If mercuric iodide is not available the following may be used :—

Mercuric chloride.. ..	50 grs.	6 grms.
Water	10 ozs.	500 c.c.s.

Add 10 per cent. potass. iodide solution until precipitate first formed is redissolved. About $1\frac{1}{2}$ oz. (75 c.c.s.) will be required, and when clear, add—

Sodium sulphite	4 ozs.	200 grms.
Water to make	20 ozs.	1,000 c.c.s.

Silver Intensifiers.

J. B. B. WELLINGTON'S FORMULA (1911).

First harden the film in :—Formaline, 1 part; water, 10 parts, for five minutes. Rinse for a few minutes, and then place for *exactly one* minute in :—

1.—Potass. ferrieyanide	20 grs.	2.3 grms.
Potass. bromide	20 grs.	2.3 grms.
Water	20 ozs.	1,000 c.c.s.

This causes no apparent change in the negative; if used too long it will bleach the negative and alter its gradation. Rinse again for a few minutes and intensify.

Stock Solutions.

A.—Silver nitrate	800 grs.	91.2 grms.
Water, distilled, to	20 ozs.	1,000 c.c.s.
B.—Ammonium sulphocyanide	1,400 grs.	160 grms.
Hypo	1,400 grs.	160 grms.
Water to	20 ozs.	1,000 c.c.s.

Take A, $\frac{1}{2}$ oz., and add slowly to $\frac{1}{2}$ oz. B, stirring vigorously (mixture should be clear); then add 10 % pyro solution (preserved with sulphite), 1 dram, and 10 % ammonia solution, 2 drams.

Place negative in chemically clean dish, best of glass, and pour solution over it. Silver begins to deposit in a minute or two. When intensified enough, place in acid fixer and well wash. Flat negatives may be over-intensified and then treated with Farmer's reducer.

ACID SILVER.

A.—Pyro.. ..	15 grs.	3.5 grms.
Citric acid	5.10 grs.	1.2 grms.
Water	10 ozs.	1,000 c.c.s.
B.—Silver nitrate	10 grs.	23 grms.
Water to	1 oz.	1,000 c.c.s.

About 1 oz. (30 c.c.s.) of A is poured over the plate once or twice, about 15 drops of B solution added, and the mixture again applied. Intensification now takes place and the solution is poured off and on until sufficient. If intensifier becomes very thick and turbid, fresh should be mixed up. When dense enough the negative is rinsed, fixed and washed. Negatives (on gelatine plates) are best hardened with alum or formaline before using this intensifier, otherwise it is difficult to avoid stains.

Chromium Intensifier.

(C. Welborne Piper.)

An excellent and convenient intensifier for general work. Results permanent.

	A.	B.	C.
Potassium bichromate ..	5 grs.	10 grs.	10 grs.
Hydrochloric acid (sp. gr., 1.160)* ..	1 minim	5 minims	20 minims
Water ..	1 oz.	1 oz.	1 oz.

Bleach in A, B or C solution, wash until yellow stain is removed, and then develop with amidol

If other developer is used, it may be necessary to expose for a short time to diffused daylight (not sunlight) during development in order to get full density. Excessive exposure before development may make it difficult to obtain density.

A gives intensification about equal to mercury and ammonia; B, to that of mercury and ferrous oxalate; and C, to that of mercury and sodium sulphite.

The process may be safely applied after fixation if the plate is simply rinsed for a minute or so.

It may be repeated several times if the first application does not give enough density.

Copper Intensifier.

Gives great intensification and is best suited for line subjects.

A.—Copper sulphate	100 grs.	230 grs.
Water	1 oz.	1,000 c.c.s.
B.—Potass. bromide	100 grs.	230 grs.
Water to	1 oz.	1,000 c.c.s.

A and B are separately made up with hot water, mixed, and allowed to cool. The negative is bleached in the mixture, and washed for a minute or two. It is then blackened in:—

Silver nitrate	45 grs.	100 grs.
Water (distilled)	1 oz.	1,000 c.c.s.

For still greater density, the negative is well washed from silver, and an ordinary developer applied.

If too dense, after the silver, it can be placed in weak hypo solution about 10 grs. per oz.) or weak potass. cyanide (about 2 grs per oz.).

Lead Intensifier.

Lead nitrate	400 grs.	46 grs.
Potass. ferriocyanide	600 grs.	70 grs.
Acetic acid	3 drachms	20 c.c.s.
Water to	20 ozs.	1,000 c.c.s.

This stock solution will keep for a long time in the dark. The negative is bleached in it, washed once *very carefully* in 10 per cent. nitric acid—the acid makes the film very tender—then in water, and then darkened in:—

A.—Sodium sulphide	1 oz.	50 grs.
Water	20 ozs.	1,000 c.c.s.

* "Commercial pure" strong acid.

Or in—

B.—Schlippe's salt	90 grs.	10 gms.
Ammonia (0.880)	6 drachms	40 c.c.s.
Water	20 ozs.	1,000 c.c.s.

Or in—

C.—Potass. bichromate	1 oz.	100 gms.
Ammonia (0.880)	$\frac{1}{2}$ oz.	50 c.c.s.
Water	10 ozs.	1,000 c.c.s.

The lead intensifier gives very great intensification, and is suited only for line-subjects.

Uranium Intensifier.

A.—Uranium nitrate	100 grs.	23 gms.
Water	10 ozs.	1,000 c.c.s.
B.—Potass. ferricyanide	100 grs.	23 gms.
Water	10 ozs.	1,000 c.c.s.

The intensifier is prepared from:—A sol., 1 oz.; B sol., 1 oz.; acetic acid, 2 drachms.

The plate must be perfectly free from hypo, and after intensification be washed in several changes of *still* water until the yellow stain is gone. A 10 gr. per oz. solution of ammonium sulphocyanide removes any yellow stain, and weak ammonia or sodium carbonate removes the intensification altogether, restoring the negative to its original state. A weak acetic acid bath should then be applied to the negative if the intensifier is to be again applied.

NEGATIVE REDUCERS.

Reduction is useful if the negative is so dense (black) that it takes long to print. Also, apart from reducing time of printing, reduction is used to improve the gradation of negatives.

For those which are too hard, usually as the result of under-exposure and too long development, the best reducer is the per-sulphate. The permanganate and bichromate are similar in their effect.

For those which, though dense, yield prints which are too flat—this is the result of great over-exposure and long development—the best is Farmer's. Belitski's is similar.

Even when density is not excessive, it is usually well, in the case of flat negatives, to reduce a little in "Farmer's," and then intensify.

The other reducers—Eder's, iodine-cyanide, and ceric sulphate—are used chiefly when it is desired somewhat to reduce negatives of good gradation.

Farmer's.

This reducer tends to remove detail in the shadows whilst leaving untouched the dense high-lights. Hence it increases contrast: "brightens up" a negative.

Hypo solution (1:5)	5 ozs.	150 c.c.s.
Potass. ferricyanide (10% sol.) ..	quant. suff.	quant. suff.

The colour is a fair indication of the strength of the reducer; it should be pale yellow, not orange, and should be used weak rather than strong, since its selective action on the shadows of a negative is then less.

Yellow stain is due usually to the use of an acid fixing bath, or an old fixing bath, instead of clean plain hypo solution. It is not easy to remove.

If the reduction is required as "even" as possible, that is, less pronounced on the shadows of the subject in the negative, use the reducer very weak, viz.: largely diluted with water.

Where the extreme of contrast is required, use a strong reducer, applying it with cotton wool, not too wet with reducer. Very useful for line negatives, where quite clear lines on a dense ground are wanted.

Belitski's.

Potass. ferric oxalate	150 grs.	10 gms.
Sodium sulphite	125 grs.	8 gms.
Water	7 ozs.	200 c.c.s.

Dissolve and add—

Oxalic acid 40 to 45 grs. 2.5 to 3.1 gms.
and shake until the solution turns green. Then pour off from undissolved crystals and add—

Hypo	1½ oz.	50 gms.
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Instead of the ferric oxalate the following more easily obtainable chemicals can be used in the formula:—

Ferric chloride cryst.	100 grs.	6.5 gms.
Potass. oxalate	190 grs.	12.5 gms.

This reducer is stainless, and keeps well in the dark. Its action on the shadow detail of the negative is similar to that of Farmer's.

Persulphate.

Ammonium persulphate	10 to 20 grs.	23 to 45 gms.
Water	1 oz.	1,000 c.c.s.

A fresh solution is made at time of use. A drop of sulphuric acid per 2 ozs. makes the action more regular. It is best also to use the reducer before the negative has dried.

When sufficiently reduced—indeed, slightly before—the negative is placed at once into 5 per cent. sodium sulphite solution.

If much reduction has taken place it is well to fix a second time. The persulphate reducer acts first on the heavy high-light densities of the negatives, reducing these without affecting shadow detail. It thus "softens" a hard negative.

Eder's (Mercury and Cyanide).

Potassium cyanide	..	..	20 grs.	5 gms.
Potassium iodide	..	..	10 grs.	2 gms.
Mercury bichloride	..	..	10 grs.	2 gms.
Water	..	..	10 ozs.	1,000 c.c.s.

Dissolve the mercury, then the iodide, and lastly the cyanide to dissolve the red precipitate formed. The solution reduces slowly, and is non-staining and intensely poisonous.

Iodine-Cyanide.

Iodine (10 per cent. sol. in potass. iodide sol.)	30 minims	6 c.c.s.
Potass. cyanide (10 per cent. sol. in water)	..	..	5 minims	1 c.c.s.
Water	..	..	1 oz.	100 c.c.s.

A very clean-acting (but intensely poisonous) reducer. Very suitable, when used quite weak, for bromide prints, as it leaves no stain.

Ceric Sulphate.

Sulphuric acid (sp. gr. 1.84)	20 minims	4 c.c.s.
Water	2 ozs.	200 c.c.s.

Dissolve in this—

Ceric sulphate	1 oz.	100 gms.
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And dilute to—

Water	10 ozs.	1,000 c.c.s.
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Hard negatives are placed wet in a mixture of this stock solution and nine times its volume of water. Reduces contrasts. Over-exposed, long-developed negatives are dipped dry into a mixture of stock solution and an equal part of water and carefully watched, as the action is very rapid. A convenient form of the reducer is the stock solution sold by Lumière.

Permanganate.

Potass. permanganate, 10% solution	..	..	1 dr.	10 c.c.s.
Sulphuric acid (10% solution by volume of 1.84 acid)	..	..	5 drs.	50 c.c.s.
Water	..	..	10 ozs.	1,000 c.c.s.

Applied to a wet negative, gives even reduction. A dry negative receives greater reduction in the high-lights, and great softening may be obtained by immersing dry negative quickly in the reducer, washing immediately, drying and re-immersing. Any brown stains are removed with a 10% solution of sodium sulphite containing 2% oxalic acid.

Bichromate.

Potass. bichromate	..	..	100 grs.	20 gms.
Sulphuric acid	..	..	7 drs. (fl.)	40 c.c.s.
Water	..	..	20 ozs.	1,000 c.c.s.

Hypochlor and Alum.

Chrome alum	10 grs.	4 gms.
Eau de Javelle	$\frac{1}{2}$ oz.	100 c.c.s.
(See "Clearing Solutions")		
Water to make	5 ozs.	1,000 c.c.s.

Immerse the negative and gently rub the surface with a piece of cotton wool. By confining friction with the wool to certain parts, extra reduction can be obtained.

Reducing Hard Negatives.

A most valuable and perfectly safe method of reducing excessively hard negatives is one dependent on re-development. Bleach the negative first in a solution of ferricyanide and potassium bromide, using the same bath as is commonly employed for sulphide toning. After a thorough wash re-develop in a developer containing 2 per cent. of rodinal and 1 per cent. of potassium bromide— that is, one containing 1 dram of rodinal and 5 drams of 10 per cent. bromide solution in 6 ozs. of water. Development will be very slow, but the plate may be left to itself for half an hour or so, as the action cannot go too far. When development is sufficient the plate is fixed, washed, and dried.

Baskett's (Local) Reducer.

It consists of—

Globe metal polish	2d. tin
Terebene	2 ozs.
Salad oil	2 ozs.

The ingredients are to be well mixed, and strained through fine muslin two or three times to remove any coarse particles. Dense parts of a negative are rubbed down with the reducer applied by the finger-tip or with a bit of chamois leather.

NEGATIVE VARNISHES.

Hot Varnishes.

No. 1.—Sandarac	4 ozs.	113 gms.
Alcohol	28 ozs.	800 c.c.s.
Oil of lavender	3 ozs.	85 c.c.s.
*This is a good varnish for retouching upon, and a tooth is easily obtained by rubbing.		
No. 2.—Seed lac	2 ozs.	50 gms.
Sandarac	2 ozs.	50 gms.
Oil of lavender	$\frac{1}{2}$ oz.	12.5 gms.
Castor oil	1 oz.	25 c.c.s.
Alcohol	40 ozs.	1,000 c.c.s.

To prepare a good surface for the retouching pencil, the negative after varnishing is dusted over with fine resin powder and rubbed up with the fingers

No 3 -White hard varnish ..	15 ozs	150 ccs.
Rectified spirit (not me thylated spirit)	20 to 30 ozs	200 to 300 ccs

This will be found a good and cheap varnish if durability is not required, as it is easily rubbed up for retouching upon and easily cleaned off. Very suitable for enlarged negatives that are not to be retained

No 4 -Bleached shellac	1½ ozs	62 gms
Mastic	¼ oz	13 gms
Oil of turpentine	¼ oz	13 ccs
Sandarac .	1½ oz	62 gms
Alcohol	20 ozs (fl)	1,000 ccs

Tough hard, and durable

No 5 Sandarac .	80 ozs	160 gms
Turpentine	36 oz	12 ccs
Oil of lavender	10 ozs	20 ccs
Alcohol	500 ozs	1,000 ccs

This one may also be rubbed down with powdered resin and gives a splendid surface for retouching

No 6 Sandarac	1 cc	55 gms
Scod lac	1½ oz	83 gms
Castor oil	3 drs	20 ccs
Oil of lavender	1½ dr	10 ccs
Alcohol	18 ozs (fl)	1,000 ccs

This varnish is somewhat dark in color

No 7 Best orange shellac	2½ oz	125 gm
Oil of lavender or oil of turpen tine	¼ oz	13 ccs
Methylated alcohol	20 ozs	1,000 ccs

Keep in a warm place until dissolved then add a large teaspoonful of whiting or prepared chalk shiko, set aside to clear, and then decant. This is specially recommended for gelatine negatives

Cold Varnishes.

No 1 -Celluloid	1 oz	10 gms
Amyl acetate	50 ozs	500 ccs

To counteract the oily character of amyl acetate add a small proportion of oil of lavender

This may be flowed over or applied with a brush to the cold negative

No. 2 -Zanzibar copal	6 ccs	30 gms
Amber (fused)	1 oz	5 gms
Ether .	60 ozs	300 ccs
Acetone	40 ozs	200 ccs
Chloroform	4 ozs	20 ccs

No. 3.—20% shellac solution	2 ozs.	160 c.c.s.
Ammonia (0.880)	3 drs.	30 c.c.s.
Methylated spirit	4 ozs.	320 c.c.s.

No. 4.—A mixture of Japanese gold size (1 part) and benzole (2 parts) forms a rather slow-drying though otherwise excellent cold varnish. The surface takes the pencil well.

SHELLAC WATER VARNISH.

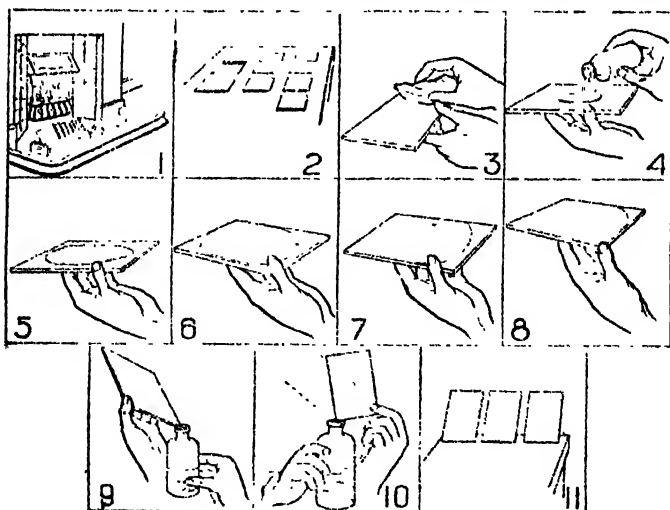
Shellac	3 ozs.	100 gms.
Sodium carbonate (saturated solution)	24 ozs.	800 c.c.s.

The shellac is allowed to soak in the liquid for twenty-four hours; the liquor is then poured away and replaced by an equal quantity of water, and the mixture boiled until the shellac dissolves. After standing some time the liquid becomes perfectly clear and bright.

How to Varnish Negatives.

Using Cold Varnish.

First place negatives where they will become perfectly dry, e.g., near a fire (Fig. 1) or on a bath hot-water tank. Next lay out to get quite cold (Fig. 2). Remove dust with a strip of cotton plush or camel's



hair brush (Fig. 3). Poise negative on the tips of fingers, steady with thumb, and pour pool of "cold" varnish (bought, or made from one of the formulae given above), in centre (Fig. 4), using plenty. Let pool spread of itself (Fig. 5). Now incline plate to cause varnish to flow into right-hand far corner (Fig. 6); thence into left-hand far corner

(Fig. 7); thence into left-hand near corner (Fig. 8), and then raise negative so as to flow excess of varnish back into bottle (Fig. 9). (N.B.—In tilting negative to distribute varnish, return plate to level position a little before varnish has reached the corner; the wave of varnish will carry the coating into corners, and you will avoid getting varnish on the glass side or up your sleeve.) As last drops run into bottle, rock negative to and fro (Fig. 10), so as to avoid a streaky coating, and as each negative is thus finished stand it on blotting-paper to dry (Fig. 11).

Film Varnishes.

The above water varnish is suitable, or the following:—

Borax	..	..	..	300 grs.	30 gms.
Glycerine	..	..	..	300 minims	30 c.c.s.
Shellac	..	..	..	600 grs.	60 gms.
Water	..	..	..	20 ozs.	1,000 c.c.s.

Boil together for about half an hour, then add—

Methylated spirit	5 ozs.	250 c.c.s.
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and filter.

Another good varnish for celluloid films is—

Danimar	500 grs.	115 gms.
Benzole	..	..	..	10 ozs.	1,000 c.c.s.

in which, after filtration, the films are immersed and then hung up to dry.

Retouching Medium.

Pale gum resin	..	..	..	200 grs.	230 gms.
Gum dammar	..	..	..	90 grs.	100 gms.
Gum mastic	..	..	..	20 grs.	23 gms.
Oil of juniper	..	..	..	1 gr.	1 gm.
Oil of turpentine	..	..	..	2 4 ozs.	1,000-2,000 c.c.s.

The gums are powdered and added to the oils, and finally enough pure asphaltum is added to give the mixture a dark amber colour when viewed through the depth of an inch.

This formula is strongly recommended by Whiting in his "Retouching" as not liable to pick, rub off, or come off on after-varnishing. It takes a great deal of work.

Ground-Glass Varnish.

Sandarac	..	..	..	90 grs.	103 gms.
Mastic	..	..	..	20 grs.	23 gms.
Ether (0 720)	..	..	..	2 ozs.	1,000 c.c.s.

Dissolve the resins in the ether and afterwards add—

Benzole	$\frac{1}{2}$ to $1\frac{1}{2}$ ozs.	120-700 c.c.s.
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The proportion of the benzole added determines the nature of the matt obtained.

This varnish must be applied to the cold negative or the coating will not be matt.

Malachite green, aurantia, or asphaltum is used for tinting it green, yellow, or brown respectively (for handwork on back of negative).

Spotting Medium.

Indian ink water colour chalk.
Payne's grey water colour chalk.

Grind together with water only on a palette to match the colour of the negative.

Blocking-Out Mixtures.

No. 1.—Gamboe and vermilion red, or Payne's grey and vermilion, are ground together in water in equal parts with addition of a little gum water if a glossy surface is required.

No. 2.—Asphaltum	1 oz.	100 gms.
Wax	170 grs.	40 gms.
Carbon black	80 grs.	20 gms.
Turpentine	10 ozs.	1,000 c.c.s.

Commercial "Brunswick black" is equal to and more convenient than the above mixture.

When printing on development papers, yellow or orange dye (Vanguard yellow or Griffin's auramine) is a convenient blocking-out medium which is easier in use owing to its transparency. First go over the film with ox gall on wet cotton-wool: the dye then diffuses slightly beyond the edge of the brush work and avoids harsh lines. In subjects containing detail such as ladies' hair, or drapery, a weak dye application over the outline will add the necessary density to the background without clogging the hair. Then proceed as usual, with a stronger wash when stray bits not wanted to print can be taken off without leaving a sharp edge.

Titles on Negatives.

The usual method is to have the words forming the title set up in type and photographed on a "process" plate. The subject negative having been made with a clear margin round it, a strip of the title negative is laid down on this margin by stripping and the clear margin then filled up with "photopake" or other blocking-out mixture except over the strip of title, which is made dense enough, in the first instance, to print white. If a clear portion in a landscape negative cannot be found (in cases where the title has to appear on the view), a piece must be cut out with a sharp knife.

STRIPPING.

Gelatine Glass Negatives.

(Middleton and Holcroft.)

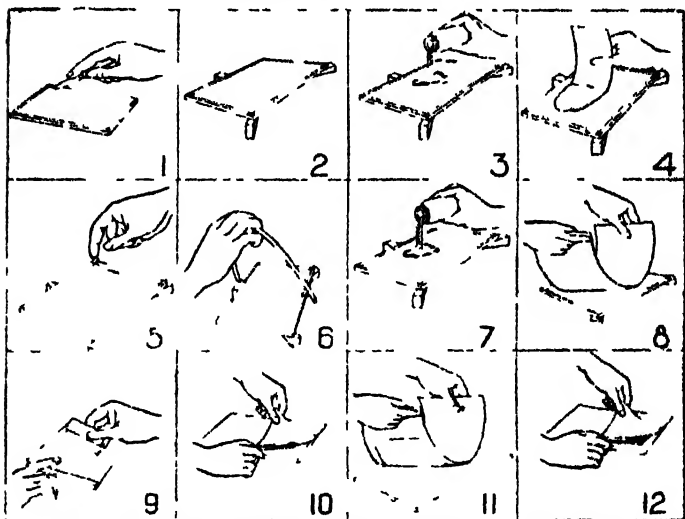
The following is the formula and process for stripping the film from a glass negative and transferring it (with or without reversal) to a second glass-plate or other support:

Stock solution:—

Methylated spirit	25 ozs.	250 c.c.s.
Water	1 oz.	10 c.c.s.
Glycerine	1 oz.	10 c.c.s.

To prepare the "stripping solution" 6 to 30 drops of commercial hydrofluoric acid are added to 1 oz. (30 c.c.s.) of the above.

Cut through to the glass all round negative, about $\frac{1}{2}$ inch from edge, with sharp penknife (Fig 1). Place level on three wooden wedges (Fig. 2). Pour on "stripping solution" (prepared as above) (Fig. 3). Spread solution with an end of paper (Fig 4). After a minute or so try (with the finger) if the edges of film are loose, and remove them as soon as they come away without any pull whatever (Fig 5). Now test if whole film is loose by passing a waxed silk thread stretched on a bow of cane underneath (Fig. 6). If all is free, pour on some plain stock solution (Fig 7), and apply a sheet of waxed paper (Fig 8). The waxed paper is prepared by soaking thin paper in hot melted paraffin for about half an hour. It is semi-transparent and free from bubble. Lightly squeegee down (Fig. 9), and then remove the two to other in contact by slipping



the blade of a penknife under the film (Fig 10). Finally, apply the paper (Fig 11), with the negative film on the under side, to a glass plate coated with very weak gum solution, dried and flowed over with "stock solution". Then squeegee down (Fig. 9) and remove the waxed sheet, using the blade of the penknife to keep the corner of the film to the glass (Fig 12).

A less rapid solution, but one which will be safe in the case of an old or hardened negative, is —

Methylated spirit..	..	..	1 oz.	80 c.c.s
Water ..	..	..	2 ozs.	160 c.c.s
Hydrofluoric acid ..	..	..	60 minims	10 c.c.s.

These proportions may be slightly altered for different commercial spirits and acids.

Film Negatives.

In the case of negatives on celluloid cut or roll-film the following is a suitable method:—

Caustic soda	10 grs.	23 gms.
Formaline	10 minims	20 c.c.s.
Water	1 oz.	1,000 c.c.s.

The celluloid negative is immersed in this solution until the film shows signs of detachment and can be rolled back with the finger. It is then placed in

Hydrochloric acid	25 minims	50 c.c.s.
Glycerine	25 minims	50 c.c.s.
Water	1 oz.	1,000 c.c.s.

in which it is removed from its original support to a glass or other base.

For stripping collodion negatives, see end of next section, "Wet Collodion and Collodion Emulsion."

WET COLLODION AND COLLODION EMULSION.

Wet Collodion.

PYROXYLINE (HARDWICH).

Sulphuric acid, 1·845	18 ozs. (fl.)	600 c.c.s.
Nitric acid, 1·457	6 ozs. (fl.)	200 c.c.s.
Water	5-5½ ozs. (fl.)	167 182 c.c.s.
Cotton-wool	300 grs.	23 gms.

Temperature 150 degrees F. (65 degrees C). Time of immersion ten minutes.

IODISED COLLODION.

For Acid Pyro Developer.

Ether, specific gravity 0·725	10 ozs. (fl.)	1,000 c.c.s.
Alcohol, specific gravity 0·805	4 ozs. (fl.)	400 c.c.s.
Pyroxyline	120 grs.	27 gms.
Ammonium iodide	30 grs.	7 gms.
Cadmium iodide	45 grs.	10 gms.
Alcohol (0·830)	4 ozs. (fl.)	400 c.c.s.

BROMO-IODISED COLLODION.

For Iron Developer.

Ether, specific gravity 0.725	..	10 ozs. (fl.)	1,000 c.c.s.
Alcohol, specific gravity 0.805	..	5 ozs. (fl.)	500 c.c.s.
Pyroxyline	..	120 grs.	27 grms.
Ammonium iodide	..	40 grs.	9 grms.
Cadmium iodide	..	40 grs.	9 grms.
Cadmium bromide	..	20 grs.	4.5 grms.
Alcohol (0.830)	..	5 ozs. (fl.)	500 c.c.s.

Thinning Collodion after Use.—A mixture of sulphuric ether (0.720), 3 parts, and alcohol (0.805), 2 parts, is generally used.

THE NITRATE BATH.

Silver nitrate	..	6 ozs.	75 grms.
Distilled water	..	80 ozs. (fl.)	1,000 c.c.s.
Nitric acid (pure)	..	8 minims	0.2 c.c.s.

Saturate with iodide of silver, which may be done by coating a plate with collodion and leaving it in the bath for some hours. Filter.

DEVELOPER.

No. 1.—Ferrous sulphate	..	1/2 oz.	50 grms.
Glacial acetic acid	..	1/2 oz.	50 c.c.s.
Alcohol	..	1/2 oz.	50 c.c.s.
Water	..	10 ozs.	1,000 c.c.s.
No. 2.—Ferrous ammonio-sulphate	..	75 grs.	43 grms.
Glacial acetic acid	..	75 grs.	43 grms.
Copper sulphate	..	7 grs.	4 grms.
Water	..	4 ozs.	1,000 c.c.s.
Alcohol	..	1/2 oz.	60 c.c.s.

INTENSIFIER.

Pyrogalllic acid	..	90 grs.	10 grms.
Citric acid	..	60 grs.	7 grms.
Acetic acid (glacial)	..	1 oz.	50 c.c.s.
Water	..	20 ozs.	1,000 c.c.s.

The copper intensifier (see "Intensifiers") is used for greater density, each solution being flowed over the plate with a rinse between.

Positives and Ferrotypes by Wet Collodion.

BROMO-IODISED COLLODION.

Ether, specific gravity 0.725	..	10 ozs. (fl.)	1,000 c.c.s.
Alcohol, specific gravity 0.805	..	5 ozs. (fl.)	500 c.c.s.
Pyroxyline	..	100 grs.	23 grms.
Cadmium iodide	..	50 grs.	11 1/2 grms.
Ammonium bromide	..	25 grs.	5 7/8 grms.
Alcohol, 0.830	..	5 ozs. (fl.)	500 c.c.s.

Note.—The iodides should be dissolved in the weaker spirit, and the pyroxyline in the ether and stronger spirit, and the two solutions mixed.

SILVER BATH.

Silver nitrate (recryst.)	5½ ozs.	70 grms.
Distilled water	80 ozs. (fl.)	1,000 c.c.s.
Nitric acid (pure)	½ dr.	0.8 c.c.

Saturate with iodide of silver and filter as above.

DEVELOPERS.

Ferrous sulphate	150 grs.	34 grms.
Glacial acetic acid	½ oz.	50 c.c.s.
Nitric acid	5 minims	1 c.c.
Alcohol	½ oz.	50 c.c.s.
Water	10 ozs.	1,000 c.c.s.

Note.—By increasing the proportion of nitric acid and decreasing that of the acetic, the image will be more metallic in appearance.

NITRATE OF IRON DEVELOPER.

Ferrous sulphate	1½ oz.	75 grms.
Barium nitrate	1 oz.	50 grms.
Water	20 ozs.	1,000 c.c.s.
Alcohol	1 oz.	50 c.c.s.
Nitric acid	40 drops	4 c.c.s.

The insoluble barium sulphate which is formed must be filtered out

FIXING SOLUTION.

Potassium cyanide	½ oz.	25-30 grms.
Water	15-20 ozs.	1,000 c.c.s.

DEVELOPER FOR COLLODION TRANSFERS.

Pyrogallie acid	4 grs.	9 grms.
Citric acid	3 grs.	7 grms.
Acetic acid	20 minims	41 c.c.s.
Water	1 oz.	1,000 c.c.s.
Alcohol	20 minims	41 c.c.s.

Wet Collodion for Half-Tone.

For Winter.

A. - Celloidin	190 grs.	21 grms.
Ether (0.720)	12 ozs.	600 c.c.s.
Alcohol (0.805)	8 ozs.	400 c.c.s.

For Summer.

B. - Celloidin	190 grs.	21 grms.
Ether (0.720)	10 ozs.	500 c.c.s.
Alcohol (0.805)	10 ozs.	500 c.c.s.

IODIZER.

Cadmium iodide	600 grs.	68 grms.
Ammonium iodide	210 grs.	24 grms.
Sodium iodide	210 grs.	24 grms.
Cadmium bromide	210 grs.	24 grms.
Alcohol	20 ozs.	1,000 c.c.s.

Use: Iodizer, 1 part; collodion, 15 parts; and set the mixture aside for at least 4 days to ripen. It should then be a bright yellow; if not, add to each ounce $\frac{1}{2}$ minim of a solution of:—Iodine, 16 grs.; alcohol, 1 oz.

Collodion Emulsion.

PYROXYLINE FOR COLLODIO-BROMIDE OR UNWASHED EMULSION.

Nitric acid, specific gravity 1.45	2 ozs. (fl.)	285 c.c.s.
Sulphuric acid, specific gravity 1.845	.. .. . 4 ozs.	570 c.c.s.
Water	1 oz. (fl.)	145 c.c.s.
Cotton (cleaned and carded) ..	100 grs.	33 grs.

Temperature, 150 degrees F. (65 degrees C.). Time of immersion 10 minutes.

FOR WASHED EMULSION.

Nitric acid, specific gravity 1.45	2 ozs. (fl.)	400 c.c.s.
Sulphuric acid, specific gravity 1.845	.. .. . 3 ozs.	600 c.c.s.
White blotting-paper	145 grs.	66 grs.

Temperature, 100 degrees F. (38 degrees C.). Time of immersion 30 minutes.

COLLODIO-BROMIDE EMULSION.

Ether, specific gravity 0.720	.. 5 ozs. (fl.)	620 c.c.s.
Alcohol, specific gravity 0.820	.. 3 ozs.	380 c.c.s.
Pyroxyline.. .. .	50 grs.	14.3 grs.
Cadmium ammonium bromide..	80 grs.	25 grs.
or		
Zinc bromide	76 grs.	21.5 grs.

Sensitise by adding to each ounce 15 grs. of nitrate of silver dissolved in a few drops of water and 1 drachm of boiling alcohol. This is suitable for slow landscape work or for transparencies.

WASHED EMULSION (for Transparencies).

Ether, specific gravity 0.720	.. 5 ozs. (fl.)	620 c.c.s.
Alcohol specific gravity 0.820	.. 3 ozs.	380 c.c.s.
Pyroxyline or papyroxyline ..	60 grs.	17 grs.
Cadmium ammonium bromide..	100 grs.	29 grs.
or		
Zinc bromide	96 grs.	27.5 grs.
Hydrochloric acid (specific gravity 1.2)	.. .. . 8 minims	2 c.c.s.

Sensitise with 20 grs. of silver nitrate to each ounce (4.3 grs. to each 100 c.c.s.), dissolved in a minimum of water with 2 drachms (13 c.c.s.) of boiling alcohol. Allow to stand for two or three days.

N.B.—In the last formula the emulsion, after being allowed to ripen for the time stated, should be poured into a dish and allowed to become thoroughly dry. The mass of dry emulsion is then washed to remove all the soluble salts, and is then again dried and redissolved in equal parts of ether and alcohol, at the rate of from 20 to 24 grs. to the ounce of solvents.

WELLINGTON'S COLLODIO-BROMIDE EMULSION FORMULA.

Pyroxyline	30 grs.	23 gms.
Ether	12 drs.	500 c.c.s.
Alcohol	12 drs.	500 c.c.s.

To bromise, add 30 grs (33 gms.) bromide ammonium dissolved in 45 minims (31 c.c.s.) water, to which 4 drachms (170 c.c.s.) of alcohol are afterwards added, 50 grs. (33 gms.) of nitrate of silver dissolved in a drachm (4½ c.c.s.) of water are then added. After washing and drying, the pellicle is dissolved in 1½ oz. (58 c.c.s.) of ether, and the same of alcohol.

DEVELOPER FOR COLLODION EMULSION

An excellent developer for collodion emulsion is the following, worked out by the Bolt Court School of Photo Engraving, London:—

Glycin	190 grs.	17 gms.
Sodium sulphite	1 oz.	40 gms.
Potass. carbonate	2 ozs.	80 gms.
Water to	25 ozs.	1,000 c.c.s.

INTENSIFYING SOLUTION FOR COLLODION EMULSION.

Silver nitrate	60 grs.	70 gms.
Citric acid	30 grs.	35 gms.
Nitric acid	30 minims	35 c.c.s.
Water	2 ozs.	1,000 c.c.s.

To each drachm of a three-grain solution of pyrogallio acid add 2 or 3 minims of the above, and apply until sufficient density is attained.

HUBL'S COLOR-BROMIDE COLLODION EMULSION.

Special for Colour Work.

A.—Silver nitrate	480 grs.	50 gms.
Hot distilled water	1 oz.	50 c.c.s.
Dissolve and add		
Alcohol	2 ozs.	100 c.c.s.
Nitric acid	6 drops	10 drops
Shake well, and add to		
4 per cent collodion	10 ozs.	500 c.c.s.

Shake till any precipitated pyroxyline is redissolved, and then add in small quantities

Zinc bromide (pure anhydrous)	307 grs.	32 gms.
Absolute alcohol	2½ ozs.	128 c.c.s.

shaking between each addition; then add

Nitric acid	24 minims	1.5 c.c.
Hydrochloric acid	24 minims	1.5 c.c.

This should be gently warmed before adding to the collodion. Allow to stand for twenty-four to thirty-six hours, or till the emulsion appears a greyish violet by transmitted light, then add

Zinc chloride (pure anhydrous)	77 grs.	3.2 gms.
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or sufficient to convert the whole of the uncombined silver nitrate into chloride, which can be tested for with potassium chromate. It is advisable to dissolve the zinc chloride in about four times its volume of acid. The emulsion should then be precipitated by pouring

into plenty of water, the threads collected and shaken up with alcohol and drained, and then dissolved in

Absolute alcohol ..	10 ozs.	500 c.c.s.
Ether, washed ..	10 ozs.	500 c.c.s.

Stripping Wet Collodion Negatives.

When the negative is thoroughly dry and cool flow over with thin solution of rubber in benzole, 2 parts pure rubber to 100 parts benzole, or ordinary cycle tyre repairing solution thinned down to about the consistency of collodion will do. When this is dry, the negative is flowed over with "leather" collodion. This is prepared by adding a small quantity of castor oil to plain collodion. A good formula is as follows

Collodion	$\frac{1}{2}$ oz	2 gms
Ether	5 ozs	50 c.c.s.
Alcohol ..	5 ozs	50 c.c.s.
Castor oil	$\frac{1}{2}$ oz	2 c.c.s.

When the collodion on the negative is dry (and the drying can be hastened by heat) the negative is cut round the edges with a knife and placed in a dish of cold water. The film should soon begin to loosen at the edges, if it does not a little acetic acid (up to 10 per cent) may be added to the water. The film is now transferred to a piece of paper, and thence to the new support. If the negative is to be reversed it is transferred to another piece of paper before being placed on its final support.

PLAIN AND ALBUMEN PAPERS.

Plain Paper.

The following are formulae for salting and sensitizing papers such as Whatman's drawing paper, pure Rives paper, etc.

First prepare the plain paper with—

Ammonium chloride	60 80 grs	14 18 gms
Sodium citrate	100 grs	23 gms
Sodium chloride	20 30 grs	4 5 7 gms
Gelatine ..	10 grs.	2 gms
Distilled water	10 ozs.	1,000 c.c.s.

or—

Ammonium chloride	100 grs	23 gms
Gelatine ..	10 grs	2 gms
Water ..	10 ozs	1,000 c.c.s.

The gelatine is first swelled in cold water and then dissolved in hot water, and the remaining components of the formula are added. The solution is filtered, and, when still warm, the paper floated upon it for three minutes and dried.

The salted paper is sensitized upon a neutral 45 grain silver bath.

PLATINUM TONING BATH.

Potass. chloroplatinite	4½ grs.	1 gm.
Water	10 ozs.	1,000 c.c.s.
Nitric acid	2-3 drops.	5-10 drops.

Albumen Paper.

The albumenized paper, as purchased, is sensitized on the following silver solution:—

Silver nitrate	600 grs.	140 grs.
Distilled water	10 ozs.	1,000 c.c.s.

The bath is made just acid with nitric acid, requiring three or four drops per 10 ozs.

TONING BATHS.

No. 1.—Gold chloride	1 gr.	0.3 gm.
Sodium acetate	30 grs.	6 grs.
Water	8 ozs.	1,000 c.c.s.

This must not be used till one day after preparation. It keeps well and gives warm, rich tones.

No. 2.—Gold chloride	15 grs.	1 gm.
Water	4 ozs.	120 c.c.s.

Add lime water until a piece of red litmus paper, placed in the solution, is turned blue. Then add

Calcium chloride, fused	120 grs.	7.7 grs.
Water to make	7½ ozs.	115 c.c.s.

This solution is diluted with 15 times its volume of water to make the toning bath; it can be used over and over again by addition of stock solution.

PRESERVATIVE FOR SENSITIZED ALBUMEN PAPER.

Sensitize the paper in the usual bath, drain well, and when superficially dry float the back of the paper for twenty minutes on a solution of—

Citric acid	1 oz.	33 grs.
Water	30 ozs.	1,000 c.c.s.

TO PREVENT BLISTERS IN ALBUMEN PRINTS.

Before wetting the prints immerse them in methylated spirit, then wash and tone as usual.

GELATINE P.O.P.

Emulsion Formulæ.

BARKER'S.

Gelatine (Nelson's No. 1 and Coignet's, equal parts) ..	175 grs.	80 grs.
Ammonium chloride	18 grs.	8 grs.
Rochelle salts	50 grs.	23 grs.
Silver nitrate	75 grs.	34 grs.
Alcohol	4 drs.	160 c.c.s.
Water	5 ozs.	1,000 c.c.s.

Heat to 100 degrees F. (38 degrees C.), and allow to remain at this temperature after all is dissolved for ten minutes, after which proceed in the usual way.

VALENTA'S.

A.—Silver nitrate	480 grs.	32 gms.
Citric acid	120 grs.	8 gms.
Hot water	5½ ozs.	160 c.c.s.
B.—Gelatine	1,440 grs.	96 gms.
Ammonium chloride	42 grs.	2.8 gms.
Water	24.3 ozs.	700 gms.
C.—Tartaric acid	42 grs.	2.8 gms.
Sodium bicarbonate	21 grs.	1.4 gm.
Alum	27 grs.	1.8 gm.
Water	5 ozs.	140 c.c.s.

Allow the gelatine to swell in the water and melt by the aid of heat, and add the chloride. Mix B and C at 50 degrees C., and in yellow light add A, heated to the same temperature, in small quantities, shaking thoroughly, and allow the emulsion to ripen for a short time at from 40 degrees to 50 degrees C. and then filter. For matt surface papers the gelatine should be reduced to 750 grs. or 80 gms.

The above formula gives vigorous brilliant prints, but for soft negatives a harder printing emulsion is obtained by adding from 0.05 to 0.1 per cent. of calcium bichromate solution; this can be made by dissolving 480 grs. or 25 gms. of pure chromic acid in 4 ozs. or 100 c.c.s. of distilled water, and adding sufficient pure chalk (calcium carbonate) to make the solution cloudy. The solution should then be filtered, and the filter washed with distilled water up to 4 ozs. or 100 c.c.s.

BEADLE'S.

Nelson's gelatine	340 grs.	112 gms.
Alum	15.5 grs.	5 gms.
Water	6½ ozs.	900 c.c.s.
Rochelle salts	15.5 grs.	3.5 gms.
Ammonium chloride	11 grs.	5 gms.

Heat to 50 degrees C., and add—

Silver nitrate	115 grs.	37.5 gms.
Citric acid	62 grs.	20 gms.
Water	1 oz.	100 c.c.s.

Procedure in P.O.P. Printing.

Wash prints in several changes of water until wash water ceases to show milkiness when poured into clean glass measure (time, 10 to 15 minutes). Tone in gold bath (5 to 10 minutes). Again wash as thoroughly as before toning. Fix in:—hypo, 2 to 3 ozs.; water, 20 ozs., for 10 minutes. Finally wash in running water or frequent changes (every 5 or 10 minutes) for 1 to 2 hours.

Prints can be toned in a platinum bath instead of in one of gold (see formulae below). The other manipulations remain the same as above. The tones are best fixed to matt surface paper,

Prints can be toned and fixed at the same time in a "combined" bath (see formulæ below). With some baths and papers it is best to wash before toning with others it is not necessary. The tones by the "combined" method are almost always warmer than by separate toning and fixing. Also they are somewhat inferior in permanence.

P.O.P. prints may be printed faintly and then developed up to full strength (see 'Developing P.O.P.' below). The colour of the developed prints is usually not pleasing and it is necessary to tone. This is done as a rule in a combined bath. P.O.P. to be developed must not be exposed to strong light before printing when loading frames or examining prints. It must be handled as though it were "gaslight" paper.

Gold Toning Baths.

SULPHOCYANIDE

This is the best and most generally used toning bath for P.O.P. and yields fine purplish tones.

Gold chloride	2½ grs	0.3 gm
Ammonium sulphocyanide	30 grs	3.5 gms
Water	20 ozs	1,000 ccs

It is necessary for this and all sulphocyanide baths to ripen. The best method of mixing is to boil the water and to dissolve the gold in one half and the sulphocyanide in the other half scalding hot. Then pour the gold into the sulphocyanide in small doses stirring all the time until cool. If cold water is used, the mixture should be allowed to stand 12 hours.

CONCENTRATED SULPHOCYANIDE

(Dunlop's Formula)

A — Distilled water	1 cz	150 ccs
Gold chloride	15 grs	5 gms
B — Strontium chloride	150 grs	50 gms
Distilled water	½ oz	100 ccs
C — Potassium sulphocyanide	80 150 grs	25 50 gms
Distilled water	1½ oz	250 ccs

Heat B to boiling and add A (heated to 150 degrees F) in small doses. Bring C to boiling, and allow to cool to 205 degrees F, and add the hot mixture of A and B in four or five lots with constant stirring, cool and filter. If a precipitate forms, reheat to nearly boiling, wash the filter with ½ oz (100 ccs) water, and add this latter to the total bulk. The bath is diluted with 10 times its volume of water for use.

FORMATE

Gold chloride	..	1 gr.	0.12 gm
Sodium bicarbonate	.	2 grs	0.23 gm
Sodium formate	.	8 grs	0.9 gm
Water	..	20 ozs.	1,000 ccs.

The prints should be immersed in a 10 % solution of salt and water before using this bath.

TUNGSTATE.

Sodium tungstate..	..	30 grs.	3 5 grs.
Sodium carbonate .	.	1 gr	0 12 gm.
Gold chloride	.	1 gr	0 12 gm
Water ..	.	10 20 ozs	500 1,000 c.c.s

An excellent bath for warm brown tones

THIOCARBAMIDE

Gold chloride	.	4 grs	0 25 gm
Distilled water ..		1 oz	25 c.c.s.
Add, to dissolve precipitate first formed, sufficient of—			
Thiocarbamide		90 grs	1 gm
Distilled water		10 o/s	50 c.c.s.
About $\frac{1}{2}$ oz (14 to 15 c.c.) will be needed. Next add			
Citric acid		8 grs	0 5 gm
and			
Distilled water to		35 ozs.	1,000 c.c.s.
and finally			
Salt .		160 grs	10 grms

The prints should be thoroughly washed *before* as well as *after* fixing

SHORT STOP FOR GOLD TONING

A weak solution of sodium sulphite (5 grs per oz) at once arrests the action of a gold toning bath

SALT BATH

A short immersion of prints in the following bath prior to the first washing favours even toning and prevents spots and stains from rusty tap water —

Salt	.	2 ozs	100 grms.
Sodium carbonate		1 oz	50 grms
Water ..	..	20 o/s	1,000 c.c.s

If prints are to be toned in the platinum bath the carbonate should be omitted.

Platinum Toning Baths.

PHOSPHORIC ACID

Potass chloroplatinite ..	.	4 grs	0 45 gm.
Phosphoric acid (sp gr 1 12)	.	$\frac{1}{2}$ oz (fl)	35 c.c.s
Water to ..	..	20 ozs	1,000 c.c.s

CITRIC ACID

Potass. chloroplatinite ..	..	4 grs	0 45 gm
Sodium chloride (salt)		40 grs	4 5 grms
Citric acid .	.	50 grs	5 8 grms
Water to ..	..	20 ozs	1,000 c.c.s.

HADDON'S FORMULA

Platinum perchloride ..	..	3 grs	0 2 gm
Sodium formate ..	.	100 grs.	6 5 grms.
Formic acid ..	..	30 minims	1 8 c.c
Water to ..	..	35 ozs,	1,000 c.c.s.

SHORT STOP FOR PLATINUM TONING.

A weak solution of sodium carbonate (10 grs. per oz.) instantly arrests the toning action of a platinum bath.

FOR BLACK TONES.

(Valenta)

Tone in—

Potass. chloroplatinite	2½ to 10 grs.	0.5 to 2 gm.
Metaphenylene-diamine	2½ to 10 grs.	0.5 to 2 gm.
Water	10 ozs.	1,000 c.c.s.

having first washed the prints well.

Another method is to print deeply and immerse the prints in—

Salt	1 oz.	25 gms.
Sodium bicarbonate	80 grs.	9 gms.
Water	20 ozs.	1,000 c.c.s.

then wash well and tone in a borax gold bath to a purple red. Again wash well and tone in the phosphoric platinum bath.

FOR RED.

(Valenta.)

Uranium nitrate	10-20 grs.	1 2 gms.
Thio-sinamine	90 grs.	10 gms.
Water	20 ozs.	1,000 c.c.s.

The prints are well washed, finally in water acidulated with acetic acid, and then toned. They are afterwards fixed, or can be toned to sepia brown in the combined bath.

GOLD-PLATINUM (One Solution).

Citric acid	90 grs.	10 gms.
Salt	90 grs.	10 gms.
Potass. chloroplatinite	4.8 grs.	½-1 gm.
Gold chloride	4.8 grs.	½-1 gm.
Water	20 ozs.	1,000 c.c.s.

Twice the amount of water may be used if the bath acts too quickly. If the proportion of gold to platinum is increased the tone is warmer. The prints must be well washed before fixing.

Combined Baths.

VALENTA'S.

Hypo	8 ozs.	400 gms.
Ammonium sulphocyanide	1 oz.	50 gms.
Lead nitrate	175 grs.	20 gms.
Alum	350 grs.	40 gms.
Water to	20 ozs.	1,000 c.c.s.

Dissolve the hypo in the water, add the sulphocyanide, then add the alum dissolved in a little water, and also the lead, and add to the hypo. Heat the mixture to 120 deg. F. for ten minutes; allow to cool. For use take—

Stock solution (as above)	10 ozs.	100 c.c.s.
Water	10 ozs.	100 c.c.s.
Gold chloride (from stock sol.) ..	¾ grs.	0.23 gm.

ALKALINE TONING AND FIXING BATH.

Gold chloride	..	..	2 grs.	0.23 gm.
Lead nitrate	..	..	10 grs.	1.2 gm.
Chalk	..	..	$\frac{1}{2}$ oz.	25 grs.
Hypo	..	..	4 ozs.	200 grs.
Water	..	..	20 ozs.	1,000 c.c.s.

Shake the solution well, allow to settle, and use the clear portion. If prints tone too quickly, under 10 minutes, in the combined bath, it is best to pass them afterwards through a plain fixing bath.

Reducer for Over-Printed Proofs.

A.—Ammonium sulphocyanide 10% sol.

B.—Potass. ferricyanide 10% sol.

A, 5 ozs. ; B, $\frac{1}{2}$ oz. ; water, 24 ozs.

This is used on the prints after toning, fixing and well washing out the hypo in the usual way.

Developing P.O.P.

DIRECT PROCESS WITH ACID DEVELOPER.

Hydroquinone	..	..	16 grs.	18.5 grs.
Citric acid	..	..	40 grs.	4.6 grs.
Sodium acetate	..	..	1 oz.	50 grs.
Water	..	..	20 ozs.	1,000 c.c.s.

Immerse the dry prints in the developer, and, after development, wash in plenty of water for ten or fifteen minutes, then tone in the usual way.

Pyro (Blacklock).

A.—Pyro	..	..	40 grs.	4.6 grs.
Tartaric acid	..	..	40 grs.	4.6 grs.
Water	..	..	20 ozs.	1,000 c.c.s.

Will keep three or four weeks.

B.—Potass. bichromate	..	..	$\frac{1}{8}$ gr.	0.009 gm.
Water	..	..	16 ozs.	1,000 c.c.s.

B is best made up from a stock solution of 1 gr. per ounce, adding $\frac{1}{8}$ dr. of it to 16 ozs. of water. To develop, mix equal parts of A and B.

Six or seven inches of magnesium ribbon burnt close to the frame will suffice for the exposure.

The fixing bath is:—

Hypo	..	..	3 $\frac{1}{2}$ ozs.	160 grs.
Lead acetate	..	..	200 grs.	23 grs.
Water	..	..	20 ozs.	1,000 c.c.s.

in which the prints lose very little.

PAGET "BROMIDE" PROCESS.

The prints are immersed in 10 per cent. potass. bromide solution for five or ten minutes, washed and developed with the following:—

A.—Hydroquinone	..	..	40 grs.	4.5 grs.
Sodium sulphite	..	..	160 grs.	18 grs.
Water to	..	..	20 ozs.	1,000 c.c.s.

B—Potass. bromide	2½ ozs.	125 grms.
Sodium carbonate	2 ozs.	100 grms.
Water to	20 ozs.	1,000 c.c.s.
C—Potass. cyanide	½ oz.	25 grms.
Water	20 ozs.	1,000 c.c.s.

For average negatives, mix —A, ½ oz., B, 1 oz., C, 20 minims ; water, ½ oz.

For flat negatives (greater contrast), A, 3 drs.; B, 1 oz ; water, 5 drs.

For hard negatives (soft results), A, 7 drs ; B, 1 oz ; water, 1 dr.

The cyanide solution is used as above in quantity sufficient to keep the backs of prints clean.

Glazing P.O.P.

POISH FOR SQUEEGING GLASSES

A polishing medium to be applied to glass or ferrotype before squeegeeing the print is —

Beeswax	20 grs	45 grms
Turpentine	1 oz.	1,000 c.c.s.

or

Spermaceti wax	20 grs	45 grms.
Benzole	1 oz.	1,000 c.c.s.

a few drops of which are rubbed on with a piece of flannel, and the glass afterwards polished with silk rag or chamois leather.

ENAMEL COLLODION.

Soluble gun cotton	50 grs.	14 grms.
Alcohol	4 ozs.	500 c.c.s.
Sulphuric ether	4 ozs.	500 c.c.s.

Glass plates cleaned with French chalk are coated with the above, and, as soon as coating has set, slipped under prints which are waiting face down in water. Prints are withdrawn and squeegeed. When half dry they are given a backing paper and finally stripped off (For both gelatine and collodion prints.)

COLLODIO-CHLORIDE P.O.P.

Emulsion Formula.

(Valenta)

1.—Strontium chloride	154 grs	10 grms.
Lithium chloride	77 grs.	5 grms.
Water	500 minims	30 c.c.s.
Alcohol (absolute)	930 minims	55 c.c.s.
2. - Silver nitrate	400 grs	20 grms.
Water	500 minims	30 c.c.s.
Alcohol	1,000 minims	60 c.c.s.
3.—Citric acid	77 grs.	5 grms.
Alcohol	675 minims	40 c.c.s.
Glycerine	92 grs.	6 grms.

In a bottle capable of holding 1,000 parts pour 350 parts of 3 per cent. collodion and add gradually 15 parts of No. 1. Then in the dark room add almost drop by drop 60 parts of No. 2, shaking well after each addition, then add 50 parts of No. 3 and 50 parts of ether. This collodion is suitable for normal negatives, but more contrast can be obtained if 0.1 to 0.4 per cent. calcium chromate solution is added. By reducing the amount of pyroxyline in the above formula the emulsion is more suitable for matt surface paper. (See "Gelatin P O P")

Procedure in C.C. Printing.

Prints are washed in changes of water until latter is free from milkiness and then toned either with gold or platinum, but most usually and for the best warm black tones, first in gold and then (after washing) in platinum. They are then again well washed and fixed like gelatin P O P prints. C C prints as a rule do not yield the best results in the combined bath. C C papers are not suitable for the "development" process described under Gelatin P O P.

Gold-Platinum Toning.

For Black Tones.

The following is the usual practice in toning collodion prints. Wash in several changes, and tone the shadows to a brown (when seen by transmitted light) in the following

Borax	..	..	90 grs	10 gms
Gold chloride	..	..	2 grs.	0.2 gm.
Water	..	..	20 ozs	1,000 c.c.s

This bath is ready within a few minutes of mixing. It is conveniently made just before washing the prints. The quantity of borax is adjusted to the working. If the lighter tones disappear, add more borax, if the prints lack brilliance, add gold. After a ten-minute wash, transfer to the platinum bath, which may be strong or weak, the only difference being that a larger number of prints may be treated together in the weaker bath.

Stock solution —

Potass chloroplatinite	..	..	30 grs.	7 gms
Phosphoric acid (specific gravity 1.12)	..	..	5 drs	30 c.c.s.
Water to make	..	..	20 ozs	1,000 c.c.s

This may be made up to 60 ozs. at once, or added little by little to water, as the prints are passed through a few at a time.

The prints are next washed in about eight changes of water (to the fifth or so of which it is well to add a little bicarbonate of soda to neutralise traces of acid) before fixing.

Gold Toning Baths.

BORAX-ACETATE.

Borax	..	..	90 grs	10 gms
Sodium acetate	..	..	90 grs	10 gms.
Gold chloride	..	..	24 grs.	0.3 gm.
Water	..	..	20 ozs	1,000 c.c.s.

SULPHOCYANIDE.

Ammonium sulphocyanide	..	90 grs.	10 gms.
Gold chloride	.. ..	2½ grs.	0.3 gm.
Water	.. ..	20 ozs.	1,000 c.c.s.

For bluish-black tones.

SULPHOCYANIDE-ACETATE.

Ammonium sulphocyanide	..	35 grs.	4 gms.
Sodium acetate	.. ..	½ oz.	45 gms.
Gold chloride	.. ..	5 grs.	0.6 gm.
Water	.. ..	20 ozs.	1,000 c.c.s.

Is made up one hour before using, preferably from stock solutions of the substances. With sodium tungstate, instead of the acetate, gives fine chestnut tones.

The maker's formulæ should be studied in connection with the above baths as papers differ considerably in the quantity of gold required in the toning solution.

Platinum Toning Baths.

The phosphate formula given above under "Gold Platinum Toning" is suitable for the production of the warm brown and sepia tones, which are given by the platinum baths alone. Others are:—

Citric acid	.. ..	45 grs.	5 gms.
Potass. chloroplatinite	.. ..	4 grs.	0.5 gm.
Water	.. ..	20 ozs.	1,000 c.c.s.

Lactic acid (specific gravity 1.21)	25 grs.	3 gms.
Potass. chloroplatinite	.. ..	4 grs.
Water	.. ..	20 ozs.
		1,000 c.c.s.

SALT-BICARBONATE BATH.

The following is used between washing and toning with the platinum bath as a means of removing free silver, and bringing the prints into a state of regular neutrality:—

Salt	.. ..	½ oz.	25 gms.
Sodium bicarbonate	.. ..	45 grs.	5 gms.
Water	.. ..	20 ozs.	1,000 c.c.s.

Toning Baths for Various Warm Tones.

For Warm Sepia Tones.

The prints are washed in three changes of warm water and placed in —

Ammonia	.. ..	1 dr.	6 c.c.s.
Warm water	.. ..	20 ozs.	1,000 c.c.s.

until they become lemon yellow. They are then again washed in three changes of water and toned for about one minute in the gold borax bath above.

For Red Chalk Tones.

The prints are washed in a couple of changes of water and placed for about half an hour (until they become orange-yellow) in :—

Salt..	..	..	..	1 oz.	50 gms.
Water	..	..	..	20 ozs.	1,000 c.c.s.

After which they are washed for about one minute and toned, for a few seconds only, in the borax bath above.

For Violet Tones.

Print deeply from the negatives and tone until the colour desired is reached in :—

Hydrochloric acid	..	..	6 ozs.	300 c.c.s.
Gold chloride	..	..	10 grs.	1.2 gm.
Water to make	..	..	20 ozs.	1,000 c.c.s.

After which wash thoroughly and fix in 5 per cent. hypo. Less acid in the above bath tends to bluish-violet, more to violet purple.

Combined Baths.

Collodion papers, although not generally suitable for use with the combined bath, may in some cases be toned in it. The Valenta formula (see "Gelatine P.O.P." above) is suitable, also the following (Kurz) :—

Water	..	..	..	20 ozs.	1,000 c.c.s.
Hypo	..	..	..	5 ozs.	250 gms
Ammonium sulphocyanide	..	..	..	240 grs.	28 gms.
Alum	..	..	..	70 grs.	7.5 gms.
Citric acid	..	..	..	70 grs.	7.5 gms.
Lead nitrate	..	..	..	90 grs.	10 gms.
Lead acetate	..	..	..	90 grs.	10 gms.
Gold chloride	..	..	..	3½ grs.	0.4 gm.

It is turbid when first made, but clears after a few days.

BROMIDE AND GASLIGHT PAPERS.

Procedure.—Bromide paper must be handled in yellow or orange light: gaslight can be worked in weak day or artificial light. Bromide papers develop in from two to five minutes, whilst many (but not all) gaslight papers develop in a second or two. Apart from these distinctions the general working of the two classes of paper is the same, viz., exposure which has no visible effect on the paper; development; a brief rinse; fixing in —hypo, 3 to 4 ozs.; water 20 ozs.;

and thorough washing in running water or frequent changes, say for one hour.

The following developers are a few only of the standard. The makers' formulae should be consulted.

Amidol.

Sodium sulphite	650 grs	74 gms.
Potass. bromide	10 grs.	1 2 gm.
Water	20 ozs.	1,000 c.c.s

When dissolved add—

Amidol	50 grs.	5 7 gms.
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This developer will not keep more than three days.

See also the formula given under "Negative Developers."

The most convenient and economical method of using amidol developer for bromide papers is to make up a 10 per cent. stock solution of sodium sulphite, and add 5 grs potassium bromide to each 10 ozs solution. For use add 4 grs dry amidol to each ounce stock solution, and dilute with an equal bulk of water.

Eikonogen-Hydroquinone.

(See under "Developers and Development")

Metol.

A.—Metol	100 grs.	11 5 gms.
Sodium sulphite .. .	2 ozs.	100 gms.
Potass bromide .. .	12 grs.	1 4 gm.
Water	20 ozs.	1,000 c.c.s.
B.—Potass. carbonate ..	2 ozs.	100 gms.
Water	20 ozs.	1,000 c.c.s.

For use take 3 ozs of A and 1 oz of B

For gaslight papers use half the quantity of water in above formula.

Metol-Hydroquinone.

Metol	8 grs.	1 gm.
Hydroquinone	30 grs	3 5 gms
Sodium sulphite	$\frac{1}{2}$ oz	37 5 gms.
Sodium carbonate .. .	$\frac{1}{2}$ oz	37 5 gms.
10% solution of potass bromide	20 minims	2 5 c.c.s.
Water	20 ozs.	1,000 c.c.s.

For gaslight papers make up above formula with 10 ozs. of water.

Rodinal.

Rodinal	100	150 minims	6-9 c.c.s
Water	10 ozs.		300 c.c.s.
10% solution of potass. bromide	20 minims		1 c.c.

Ortol.

A.—Ortol	.. ..	120 grs.	14 grs.
Potass. metabisulphite	.. ..	60 grs	7 grs.
Water	.. ..	20 ozs	1,000 c c s.
B.—Sodium sulphite	.. ..	4 ozs	200 grs
Potass carbonate	.. ..	1 oz	100 grs
Potass. bromide	.. ..	20 grs	23 grs
Water	.. ..	20 ozs	1 000 c c s

Use equal parts of A and B

For gaslight papers use half the quantity of water given in this formula.

Ferrous Oxalate.

A — Sulphate of iron	.. ..	5 ozs	250 grs.
Sulphuric acid	.. ..	30 minims	3 c c s
Warm water to	.. ..	20 ozs	1,000 c c s.
B — Potass oxalate (neutral)	.. ..	5 ozs	250 grs
Potass bromide	.. ..	10 grs	12 grs
Warm water to	.. ..	20 ozs	1 000 c c s

For use add 1 oz of A to 4 ozs of B *not vice versa!*

After development and without washing, immerse the prints for two minutes in acid bath pour off and repeat

ACID BATH

Glacial acetic acid	.. ..	1 dr	6 c c s
Water	.. ..	20 ozs	1 000 c c s

Then wash thoroughly to remove last trace of acid

Clearing Bath.

To remove yellow stain from bromide prints, the following is suitable —

Alum (saturated solution)	.. ..	10 ozs	1 000 c c s.
Hydrochloric acid	.. ..	3 drs	40 c c s.

Reducer for Bromides.

Over developed prints are best treated in a weak iodine cyanide reducer made from (A) 10% solution of iodine in potass iodide and (B) 10% potass cyanide solution Take —

A.	.. ..	30 minims	2 c c s.
B	.. ..	10 minims	0 6 c c
Water	.. ..	2 ounces	60 c c s

Adding more of A and B if necessary.

Strong Prints from Flat Negatives.

The prints are fully exposed and over-developed, fixed and washed. They are then placed in the following iodine bath until whites are strongly blue, and then fixed for five minutes.

IODINE BATH.

Potass. iodide	..	..	..	30 grs.	7 gms.
Iodine	..	..	..	3 grs.	0.7 gm.
Water	..	..	..	10 ozs.	1,000 c.c.s.

If not sufficiently lightened, the print may be washed and the process with bleaching bath and hypo repeated.

Stress Marks on Bromides.

Avoid rubbing paper against other sheets in boxes or packets, and against negative or mask. In cutting up large sheets, use shears on open sheet, not knife, etc., which rubs on emulsion surface. Have developer water clear, free from sediment and any floating dirt. Use plenty of developer.

Addition of from 40 to 60 in. ams of 10 per cent. solution of potass. cyanide to each 10 ozs. of developer will avoid stress marks in many cases, or a developer may be made up as follows:—

Soda sulphite	.....	1 c.c.	50 gms
Water	.....	20 ozs.	1,000 c.c. s.
Potass. bromide	.....	2 grs.	0.23 gm.
Amidol	.....	35 grs.	4.0 gms.
Potass. cyanide	.....	2 grs	0.23 gm.

If stress marks occur, they can usually be removed by gently rubbing each print with a soft rag as soon as it has had a minute or so in the wash-water. A further aid to removal is a solution of borax, $\frac{1}{2}$ oz.; water, 20 ozs.; methylated spirit, 5 ozs., rubbed over with soft rag or cotton wool.

Hypo-Alum Toning.

The following is a method (much used on the commercial scale) for toning bromide prints to a warm purplish sepia:—

Hot water	20 ozs.	1,000 c.c.s.
Hypo	2½ ozs.	125 gms.

Dissolve and add—

Alum	½ oz.	25 gms.
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This mixture should not be filtered, and it works better as it becomes older; it may be strengthened from time to time with a little fresh solution.

The best results are obtained by keeping the bath hot, or as warm as the emulsion will stand, say 100 to 120 degrees F. In this bath prints will tone in 30 to 40 minutes. When this toning bath is to be employed, the use of the alum bath after fixing is absolutely essential. Moreover, the prints should not, in this case, be subjected to a prolonged washing, but should only be slightly rinsed before being dried.

A new bath tends to reduce the prints rather more than an old one.

When toned the prints should be placed in a tepid solution of—

Water	..	..	..	70 ozs.	1,000 c.c.s.
Alum	..	..	..	2 ozs.	30 gms.

and then washed thoroughly.

Sulphide Toning.

Of the many methods of producing sepia to warm brown tones on bromide or gaslight the following is the best and most reliable. Prints require to be well washed from hypo before being put into the bleacher. In summer, or in places where the water supply has a softening action on prints, it is well to fix them in a fixing hardening bath. (See "Fixing.")

BLEACHER.

Ammonium bromide	..	..	100 grs.	11 gms.
Potass. ferricyanide	..	..	300 grs.	35 gms.
Water	..	..	20 ozs.	1,000 c.c.s.

SULPHIDE BATH.

It is best to keep the sulphide in strong, 20 per cent., solution; a weak solution does not keep well. Use the pure *white* sulphide, dissolving 4 ozs. in water and making up to 20 ozs.

To make the working sulphide bath, mix :—

Stock 20% sulphide solution	..	..	..	3 ozs.
Water to make	..	..	..	20 ozs.

The prints are treated for two or three minutes in the bleacher—that is, until the picture becomes faint brown in colour. If any black is left at the end of two minutes it is a sign that the bleacher (which may be used repeatedly) is becoming exhausted.

Rinse in clean water for half-a-minute to one minute. Longer washing at this stage does no good and may lead to impaired tone.

Transfer to sulphide bath, where prints should darken to the full brown or sepia in a second or two.

Throw away the sulphide bath after the day's use. Stale spoilt sulphide solution is the most frequent cause of bad tones or of refusal of prints to darken in the sulphide bath.

Finally wash for half-an-hour in running water.

The results by the sulphide process are quite permanent.

Blue stains in spots and patches, on sulphide toned prints, are due to iron, either as rust in the tap-water, or as impurity in alum. Fit a flannel filter to the tap and use pure alum. Wiping with cotton-wool saturated with strong hydrochloric acid will slowly change the stain to yellow which washes out in water. But it is a rather risky remedy.

Sulphide-toned prints of bad colour or insufficient depth can be re-treated, e.g., by bleaching in :—copper bromide, 130 grs.; sodium bromide, 2½ ozs.; water, 10 ozs. This is used in the dark-room, the bleached print taken into daylight and re-developed with amidol or other clean developer, after which it may be retoned.

Permanganate Bleach Process.

(T. H. Greenall's formula.)

This process allows of prints being toned after a very brief rinse from the fixing bath; also it requires no washing (or only the briefest) between bleaching and sulphiding.

BLEACHER

A.—Hydrochloric acid B P. 31.8° ..	3 ozs	150 c.c.s.
Water to make ..	20 ozs	1,000 c.c.s.
B.—Potass permanganate ..	40 grs	4.5 gms
Water ..	20 ozs	1,000 c.c.s.

Both A and B keep indefinitely when well stoppered

To make the bleacher, mix in order given Water, 6 o/s, A, 1 oz, B, 1-oz. Cost of working mixture is about 1d per 20 o/s. If prints do not bleach completely, throw bleacher away and mix fresh. Any brown stain disappears in the sulphide bath, which should be of strength 1 gr per oz made up from strong solution.

If, by using more of A or B than directed above, there is any brown stain on sulphided prints a bath of oxalic acid 4 oz, water, 50 o/s., with a few crystals of soda sulphite dissolved in it, will at once remove them.

Copper Toning.

This process yields a range of tones from warm black to red chalk, the warmth of tone increasing as the solution acts on the print. The process does not intensify the prints. It is cheap and the results are permanent.

A.—Copper sulphate ..	50 grs	7 gms
Potass citrate (neutral) ..	240 grs	28 gms
Water ..	20 ozs.	1,000 c.c.s.
B.—Potass. ferricyanide ..	50 grs	6 gms
Potass citrate (neutral) ..	240 grs	28 gms
Water ..	20 o/s	1,000 c.c.s.

Use equal parts of each. If prints are pinkish in the high-lights, use more citrate in the A or B solution.

Platinum Toning.

Not for Gaslight Prints

Potass chloroplatinite ..	12 grs.	0.8 gm.
Mercuric chloride., ..	6 grs	0.4 gm.
Citric acid ..	54 grs.	3.4 gms
Water ..	6 ozs.	170 c.c.s.

This bath should be made up fresh for use from stock solutions. Gives warm sepia tones, with slight staining of high lights. For cold sepia tones and absence of staining add 30 minims 10 per cent. solution potassium bromide to above. Wash well after toning.

Uranium Toning.

This old method yields brown to reddish tones. It intensifies the prints, and the results often prove impermanent.

A.—Uranium nitrate ..	90 grs	10 gms
Water ..	20 ozs.	1,000 c.c.s.
B.—Potass. ferricyanide ..	90 grs	10 gms
Water ..	20 ozs.	1,000 c.c.s.

Use equal parts of A and B, and add 20 minims of glacial acetic acid to each ounce of mixture. The prints must be free from hypo.

After toning wash in several changes of still water till the high lights are clear. Washing in running water will remove the toning in patches. Citric acid (10 grs per oz) or oxalic acid (5 grs per oz.) instead of acetic is an aid to pure whites.

As a means of rendering uranium toned prints permanent, it is recommended to fix the toned prints for five minutes in hypo. 3 oz; potass metabisulphite 70 grs water 20 ozs

Green Tones.

(H. F. Smith's formula without scheduled ingredients)

A - Potass ferric cyanide	.. 180 ccs	2 grms
Water distilled	.. 20 "	100 ccs
B Vanadium chloride stock solution	3 1/2 drs	4 ccs
Ferric ammonium citrate (green acids)	15 grs	1 gm
Sodium citrate neutral (Merck)	2 1/2 ccs	25 grs
Ammonium chloride	90 grs	2 grms
Hydrochloric acid, strong pure	1 1/2 ozs	14 ccs
Water distilled	10 ccs	100 ccs

The stock vanadium solution is made by mixing 1 cc of vanadium chloride as purchased (Merck's syrupy), with 5 drams (12 ccs) of strong hydrochloric acid and then adding distilled water to make 2 ozs 90 minims (62 ccs) in all.

In making up the B solution first add the hydrochloric acid to the vanadium solution. Then dissolve the ferric citrate and citrate, and ammonium chloride in the 10 ozs (100 ccs) water and mix the two. Solution should be dull mauve blue not green until mixed with A.

Both A and B solutions will keep for months at least.

To mix the toning solution take 1 part A with 4 parts water and, separately, 1 part B with 4 parts water. The two weak solutions when mixed together form the toner.

Prints tone in from 4 to 8 minutes. Rock constantly then wash in 5 changes of water each of 2 minutes give a bath of hydrochloric acid (1 part in 50 parts water) for 2 minutes and finally wash for 15 minutes in 7 or 8 changes of water.

Prints should be of the ordinary depth. The green tone is permanent.

Blue Tones.

10% solution ferric ammonium citrate	2 ozs	10 ccs
10% solution potassium ferricyanide	2 ozs	10 ccs
10% solution acetic acid ..	20 ccs	100 ccs.

The well-washed prints are immersed in this bath until the desired tone is given. Then well wash until high lights are clear. This bath intensifies the image.

Gold Toning.

This process considerably improves the colour of greenish or rusty black prints, and if allowed to act for some time bluish tones are obtained.

Ammonium sulphocyanide	..	30 grs.	2 gms.
Chloride of gold	.. .. .	2 grs.	0.13 gm.
Boiling water	.. .. .	4 ozs.	110 c.c.s.

Use as soon as cool. Place the wet print face upwards on a sheet of glass, squeegee into contact, blot off superfluous moisture, and paint the above bath on with a broad flat brush; when the desired tone is reached wash well and dry.

* * * * *

Practically all the above toning solutions can be employed for lantern plates.

Line Drawings from Bromide, Gaslight, or P.O.P. Prints.

After outlining the subject in waterproof Indian ink, bleach out the image in—

Thiocarbamide	.. .. .	240 grs.	25 gms.
Nitric acid	.. .. .	4 drs. (fl.)	25 c.c.s.
Water	.. .. .	20 ozs.	1,000 c.c.s.

Or in—

Iodine sol. (10 per cent. in potass. iodide sol.)	.. .. .	30 minims	6 c.c.s.
Potass. cyanide (10 per cent. sol. in water)	.. .. .	5 minims	1 c.c.
Water	.. .. .	1 oz.	100 c.c.s.



THE CARBON PROCESS.

Procedure.—Tissue, i.e., paper coated with a mixture of gelatine and pigment colour, is made sensitive by immersion in bichromate solution, dried, and printed under the negative by daylight. As the colour of the tissue hides the effect of light, the printing is done by aid of an actinometer.

The effect of the light is to render the gelatine insoluble—deeper down into the tissue, the greater the action. "Development" consists in dissolving out in warm water the tissue which remains soluble. As a skin of insoluble tissue is formed over the whole top surface of the print, the coating is first transferred (face down) on to a fresh support. To do this, the exposed tissue is soaked in cold water along with a sheet of (gelatine-coated) transfer paper, the two squeegeed together, put under pressure for about 20 minutes, and then placed in

hot water. The original support of the sensitive surface is stripped off, leaving the tissue with its face (the insoluble side) on the transfer paper. The soluble gelatine can be then dissolved away (development), carrying the pigment with it, and the prints are finally passed through an alum bath, washed and dried. As this transference of the print to a new support causes the picture to appear reversed as regards right and left, it is necessary (where this is an objection) to transfer first on to a "temporary support," and from this again on to the "final support" for development.

Sensitising Solutions.

Potass. bichromate	..	..	1 oz.	35-50 gms.
Water	..	..	20-30 ozs.	1,000 c.c.s.
Liquor ammonia (0-880)	..	..	60 minims	6 c.c.s.

A longer immersion in the weaker solution is practically equal to a shorter one in the stronger bath.

If the tissue is squeegeed on a glass plate after sensitising, the degree of squeegeeing (light or heavy) also modifies its sensitiveness by removing more or less of the solution. If the tissue be squeegeed on to a errotypes plate, and allowed to dry upon it, the drying may be done in the light of an ordinary room. The face of the tissue is then protected from light, dust, and injurious vapours.

The following has been recommended:—

Potass. bichromate	..	..	1 oz.	20 gms.
Water	..	..	50 ozs.	1,000 c.c.s.
Citric acid	..	..	$\frac{1}{2}$ oz.	5 gms.
Liquor ammonia	..	..	q.s. to change tint of solution to lemon yellow.	

This bath is suitable for thin negatives, i.e., those lacking in contrasts, and the tissue sensitised in it will keep longer than that sensitised in the former solution. The tissue, however, is much less sensitive, and with vigorous or contrasty negatives, such as are best suited for carbon work, it is apt to yield prints that are hard, through the washing away of the more delicate tones in the development.

FIXING OR HARDENING BATH.

Alum	..	..	1 oz.	50 gms.
Water	..	..	20 ozs.	1,000 c.c.s.

Waxing Solutions.

FOR CARBON PRINTS, OR FOR REMOVING COLLODION FILMS.

No. 1.—Beeswax	..	..	20 grs.	10 gms.
Benzole rect.	No. 1	..	4 ozs.	1,000 c.c.s.

FOR FLEXIBLE SUPPORTS (AUTOTYPE).

No. 2.—Yellow resin	..	..	180 grs.	42 gms.
Yellow beeswax	..	..	60 grs.	14 gms.
Rectified spirits of turpentine	10 ozs.			1,000 c.c.s.

Gelatine Solutions.

For transferring carbon pictures from flexible support to ivory, opal, glass, &c

Nelson's No 1 gelatine ..	1 oz	50 gms
Water	1 pint	1,000 c.c.s.
Chrome alum, dissolved in 2 ozs (100 c.c.s.) hot water ..	12 grs	1.4 gm

For coating drawing papers for the single transfer process—

Nelson's No 1 gelatine ..	1 oz	50 gms
Water	1 pint	1,000 c.c.s.
Chrome alum, dissolved in 2 ozs (100 c.c.s.) water ..	20 grs	2.3 gms

Apply with a brush

Note—In adding a solution of chrome alum to one of gelatine, both solutions should be at a fairly high temperature, 130 degrees to 160 degrees F

SUBSTRATUM FOR CARBON TRANSFERENCES

Nelson's No 1 gelatine ..	3 oz	37 gms
Water	20 ozs	1,000 c.c.s.
Potassium bichromate ..	12 grs	1.4 gm

Well-cleaned plates are coated with this and dried, when they are fully exposed to light, when it will render the coating insoluble

TO REMOVE BICHROMATE STAINS FROM FINISHED NATES

Apply dilute ammonia to the parts until the stains disappear, then well wash the hands with warm water and soap

THE OIL PROCESS.

Procedure—Gelatine coated paper is sensitised with bichromate, printed under the negative and treated in cold water. The faint image has the power of fixing greasy ink. This is applied with a brush usually a continuation or suppressing parts of the subject at the worker's discretion.

Double transfer papers as used in the carbon process or other papers (gelatine coated) sold in the shops are sensitised in a solution of bichromate of potash of 5 per cent strength is for carbon printing. The citric acid sensitiser given above under 'Carbon' is very suitable, but the most satisfactory method on the whole is the use of a quick drying spirit sensitiser.

SPIRIT SENSITISER

(Demulhy)

Prepare 6 per cent ammonium bichromate by dissolving 1½ ozs. of this salt in 25 ozs. of water

To make the sensitiser mix at time of use—

Stock bichromate solution	1 part
Alcohol, pure, 90°	2 parts

The sensitiser is applied with a flat hog-hair brush, about $\frac{1}{2}$ oz. serving for six 10×8 sheets of transfer paper.

The paper dries in about 18 minutes, and is printed under the negative until it shows a brown image as in the platinum printing process. The detail should show in the high lights. It is then soaked in several changes of water to remove the yellow bichromate (about 20 minutes), and then soaked for a further time (in a dish of water), depending on the thickness of the gelatine coating. An average time is 30 minutes, 2 to 3 hours for more heavily coated papers. The temperature of the water should be between 65° and 70° F., and should be kept steady by placing the dish in a place at this temperature. The print can be pigmented forthwith, or dried for pigmenting later on. If it is dried it requires about an hour's soaking in water at 65° to 70° F. to bring it into the best condition for pigmenting.

THE BROMOIL PROCESS.

In this form of the oil process a bromide print or enlargement is treated so as to remove the image and at the same time bring the print into the same condition as that produced by exposure of sensitised paper in the oil process.

C. Welborne Piper's Formula.

The bromide enlargement must be fully exposed and developed, using a slow-acting amidol developer for preference, and it must be thoroughly fixed, washed, and dried. It is then bleached in—

Ozobrome solution	4 parts
Potash alum, 10% solution .. .	4 parts
Citric acid, 10% solution .. .	1 part
Water to make	20 parts

It is washed and then immersed in sulphuric acid (1 part to 10 water) for from 2 to about 5 minutes, again washed by soaking for a few minutes, and then fixed for 2 or 3 minutes in—

Hypo	2 ozs.
Soda sulphite	$\frac{1}{2}$ oz
Water to make	20 ozs.

After this it is washed again and then pigmented like an ordinary oil print. The solutions and washing water used should not be under 60° deg. or over 70° deg. F., and the preparation of the print should not occupy longer than 20 minutes.

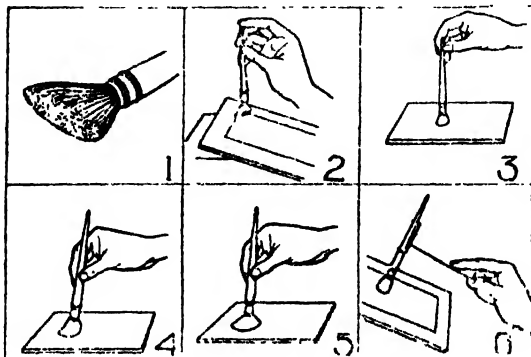
The ozobrome solution used is that specially supplied for bromoil by the Ozobrome Company.

The above is the process originally published by Mr. Welborne Piper, and is still as reliable a method as any. For alternative bleachers, etc., which have been proposed, see "Epitome of Progress," B.J.A., 1900, p. 618; 1910, p. 571; 1911, p. 587; 1912, p. 628; 1913, p. 672; 1914, p. 671, and 1915, p. 490.

Pigmenting Oil and Bromoil Prints.

The brush chiefly used is the *pied de biche*, or hare's foot, of dome shape (Fig. 1).

In dabbing on pigment, rest elbow on table, press bristles at toe of brush first on paper, and bend and spread a little before heel comes down (Fig. 2).



Another touch is to hold brush lightly between first two fingers and thumb, lower brush on to print, and dab four or five times a second, the brush hardly leaving surface (Fig. 3).

Or hold brush (firmly) lower down (Fig. 4).

And apply vigorously, with slight dragging action, from heel to toe for strong effects (Fig. 5).

In "hopping," hold brush on wire and apply in taps, coming an inch or so from print each stroke (Fig. 6), lightens light and strengthens dark tones.

PLATINUM PRINTING.

In the platinum process, paper is coated with a mixture of sensitive iron (ferrio) salts with which are platinum salts. By exposure to light the ferrio salts become reduced to ferrous salts, and then are able to reduce the platinum in the paper as a black or sepia deposit, forming a highly permanent print. The "developer" in which this takes place is a solution by which the ferrous salts are brought into a soluble state. The developer is used hot or cold, according to the nature of the paper and the kind of tone required.

Sensitisers for Cold Bath Papers (Häbl).

STOCK SOLUTIONS.

Standard Iron Solution—In glass measure about 3 ins. diameter and 12 ins. high (marked to show a volume of 85 c.c.s.) place 52 gms. powdered iron ammonium alum, and add about 20 c.c.s. ammonia (0.880) and 20 c.c.s. water. Stir up the alum powder with a glass rod, and allow to stand several minutes, with frequent shaking. The whole should smell slightly of ammonia; if it does not a little more is added. The measure is then filled with water, the precipitate of ferric hydroxide stirred up, the glass rod removed, and the ppt. left to settle. The clear liquid is poured off, fresh water poured on, and the stirring and settling repeated until the solution no longer colours red litmus-paper blue. Powdered oxalic acid (21.5 gms.) is then dusted on the ppt., after pouring off the last washing water, and (in yellow light from this point) stirred in until the mixture clears. It is poured into a 100 c.c. measure, and diluted (with rinsings from the cylinder) to 100 c.c.s. Process occupies three to four hours.

Lead-Iron Stock Solution.—Dissolve lead acetate (10 gms.) in warm water (100 c.c.s.), and add oxalic acid (4 gms.) dissolved in a little water. A white precipitate of lead oxalate is produced, and is filtered, washed, and shaken up, with Standard Iron Solution in proportion of 1 gm. per 100 c.c.s. Finally, filter.

Oxalic-Gelatine Solution.—Soak gelatine (2 gms) in water (20 c.c.s.), and add oxalic acid ($\frac{1}{2}$ gm.). Warm before use. Keeps only a day or two.

Stock Platinum Solution.—Potash chloroplatinate, 1 gm.; water, 6 c.c.s.

Mercury Citrate Solution.—Dissolve yellow mercuric oxide (1 gm.) in water, 20 c.c.s.; citric acid, 5 gms., warm and filter.

SENSITISERS.

The quantities are for a 20 by 30 inch sheet. Water is added for medium (2 to 3 c.c.s.) and for rough (3 to 8 c.c.s.) papers.

A.—Lead-iron solution 4.5 c.c.s.

Stock platinum solution 3 c.c.s.

For black tones on gelatine-sized Rives papers.

B.—Lead-iron solution 4.5 c.c.s.

Stock platinum solution 3 c.c.s.

Oxalic-gelatine solution 1 c.c.

For blue-black tones on arrowroot-sized papers.

For more brilliant prints 5 to 10 drops of 10% solution of sodium chloroplatinate are added to either of the above.

Sepia Paper Sensitisers.

HOT DEVELOPMENT.

Standard iron solution 6 c.c.s.

Stock platinum solution 4 c.c.s.

Mercuric chloride (1 in 20 solution) 0.2 to 1 c.c.

Sodium chloroplatinate (10% solution) 2 to 10 drops.

COLD DEVELOPMENT.

Standard iron solution	8 c.c.s.
Stock platinum solution	4 c.c.s.
Mercury citrate solution	1 to 4 c.c.s.
Sodium chloroplatinate (10% solution) ..	2 to 5 drops.

For rough papers 2 to 4 c.c.s. of water are added.

Procedure in the Platinum Process Prints are developed by floating for from 15 seconds to 1 minute on a bath, the chief chemical in which is always potash oxalate. Without washing they are placed in a bath (No. 1) of 1 in 80 pure hydrochloric acid for 5 minutes, into a second bath for 5 minutes, a third into a third, and are then washed in running water for 15 minutes. Time in all, about half an hour.

Cold Bath Developers.

Potass. oxalate	2 ozs.	100 gms.
Potass. phosphate	1 oz.	50 gms.
Water	20 ozs.	1,000 c.c.s.

FOR SEPIA TONIS ON COLD BATH BLACK PAPER.

A.—Potass. oxalate	2 ozs.	20 gms.
Water	15 ozs.	150 c.c.s.
B.—Potass. citrate	160 grs.	23 gms.
Citric acid	250 grs.	39 gms.
Mercuric chloride	95 grs.	14 gms.
Water	15 ozs.	1,000 c.c.s.

Equal parts of A and B, used slightly warm. The prints are afterwards fixed in acid baths of one third the usual strength.

Another Formula.

Prepare the following solutions —

1.—Potass. oxalate	4 ozs.	250 gms.
Distilled water	16 ozs.	1,000 c.c.s.
2.—Cupric chloride	124 grs.	35 gms.
Distilled water	8 ozs.	1,000 c.c.s.
3.—Mercuric chloride	1 oz.	62 gms.
Distilled water	16 ozs.	1,000 c.c.s.
4.—Lead acetate	32 grs.	18 gms.
Distilled water	4 ozs.	1,000 c.c.s.

Mix 12 parts of No. 1 with 4 parts No. 2, then add 4 parts No. 3 and 1 part No. 4, and heat till the precipitate first formed is redissolved. The solution should be heated to 175 degrees F., and the prints developed in it in the usual way and treated to the usual acid clearing baths, then immersed in ammonia solution (about 10 minims per oz.) for 5 minutes, and washed and dried.

Developer for Sepia Paper.

HOT BATH.

Potass. oxalate ..	..	..	2 ozs.	100 gms.
Potass. phosphate ..	..	..	1 oz.	50 gms.
Citric acid ..	..	..	180 grs.	20 gms.
Potass. chloride ..	..	..	90 grs.	10 gms.
Water ..	..	..	20 ozs.	1,000 c c s.

Various Platinum Formulæ.

RECOVERING OVER EXPOSED PRINTS

Immerse for about two minutes in the oxalate developer. Transfer for one second to a bath of 1 to 20 hydrochloric acid. Return to the developer, and treat as usual.

INTENSIFIER FOR PLATINUM PRINTS

A	Sodium formate	45 grs.	100 gms.
	Water	1 oz.	1,000 c.c.s.
B	Platinum perchloride	10 grs.	1 gin.
	Water	1 oz.	45 c.c.s.

Add 15 minims each of A and B to 2 ozs. of water (3 c.c.s. to 100 c.c.s.)

RESTORING YELLOWED PRINTS.

Shake up bleaching powder with about five times its weight of water, pass through a sieve, and to the portion which passes through add a little weak hydrochloric acid—enough to give the mixture a faint chlorine smell. The solution removes the yellow (iron) stain from platinum prints.

CLEANING SOILED PRINTS

Alum (one teaspoonful) is dissolved in about 8 ozs of water, and mixed in a basin with a handful of flour to a cream like consistency. This mixture is applied to the platinum print with a soft brush, and washed off in running water.

PLATINUM RESIDUALS.

Exhausted developers—and the acid baths if in quantity are mixed in a large jar, with zinc and hydrochloric acid (spirits of salt will do). A dirty chalk like precipitate is accumulated, and the clear liquor is thrown away. The platinum is precipitated in the mud, and the latter, when enough has accumulated, is sent to the refiners, after being drained from water as much as possible on a linen cloth.

Waste prints, clippings from paper, etc., should be sent as they are or burnt to an ash in a place free from draught, such as a biscuit tin with a row of holes about half way up. They should not be mixed with the wet residues, as the two require different treatment for the extraction of the metal.

IRON PRINTING PROCESSES.

Ferro-Prussiate Sensitiser.

This ferro-prussiate or "blue" paper gives prints of Prussian blue colour from ordinary (brilliant) negatives. From line drawings, plans, etc., it supplies copies in white lines on a blue ground.

A.—Ferrie	ammonium	citrate		
(green)*	..	..	..	110 grs. 250 grms.
Water	..	..	..	1 oz. 1,000 c.c.s.
B.—Potass. ferricyanide	..	..	40 grs	90 grms.
Water	..	..	1 oz.	1,000 c.c.s.

Mix in equal parts, keep in the dark, and filter just before use.

The sensitiser is applied with a brush or sponge. The paper is printed until the shadows bronze, and is "developed" simply by soaking in one or two changes of plain water.

Solution for Writing Titles on, removing blue lines from, blue prints, etc.—Potass. oxalate, 75 grs. per oz.; 170 grms. per 1,000 c.c.s.

Brightening the Colour—Blue prints are improved in colour by a final bath of $2\frac{1}{2}$ per cent. alum solution, 3 per cent. oxalic acid, or 1 per cent. hydrochloric acid.

The Kallotype Process.

Paper, sensitised as below, is printed to a semi visible image, like platinum paper. It yields prints from black to sepia, according to the developer. If prints are fixed in a mixture of hypo and ammonia, the results appear to be permanent.

SENSITISER.

Ferrie oxalate (Merck pure and fresh) 20% sol.	..	..	1 oz.
Ferrie potass. oxalate, 1 : 16 sol.	..	..	$\frac{1}{2}$ oz.
Oxalic-ammonia sol. as below	..	..	30 minims
Potass. bichromate, 1 : 16 sol.	..	..	4 drops
Silver nitrate	..	..	36 grs.

The oxalic-ammonia solution is:—Oxalic acid, 240 grs.; ammonia, 880, 100 minims; water, 4 ozs.

Paper thus sensitised yields prints of full gradation and half-tone from ordinary negatives, such as print well in P.O.P. For flat negatives further bichromate solution may be used in the developer.

* If the ordinary brown citrate be used, the formula should contain 80 grs. (137 grms.), and the ferrioye side should be increased to 60 grs. (137 grms.).

DEVELOPERS.

For Black Tones.

Borax	..	..	..	2 ozs.	100 gms.
Rochelle salt	..	..	..	1½ ozs.	75 gms.
Water	..	..	..	20 ozs.	1,000 c.c.s.
Potass. bichromate sol. (1%)	15-18 drs.	90-115 c.c.s.

For Purple Tones.

Borax	..	..	..	1 oz.	28 gms.
Rochelle salt	..	..	..	2 ozs.	100 gms.
Water	..	..	..	20 ozs.	1,000 c.c.s.
Potass. bichromate sol. (1%)	15-18 drs.	90-115 c.c.s.

For Sepia Tones.

Rochelle salt	..	..	..	1 oz.	50 gms.
Water	..	..	..	20 ozs.	1,000 c.c.s.
Potass. bichromate sol. (1 %)	..	..	..	8-10 drs.	50-60 c.c.s.

Prints are allowed to remain in either of the above developers for from 15 to 30 minutes.

For Black Tones.

Sodium acetate	..	..	..	3 ozs.	150 gms.
Water	..	..	..	20 ozs.	1,000 c.c.s.

From this developer prints must be passed into a bath of potass. oxalate (15 %) before fixing.

FIXING SOLUTION.

Hypo	..	..	..	1 oz.	200 gms.
Ammonia (0.880)	..	..	..	120 minutes	12 c.c.s.
Water	..	..	..	20 ozs.	1,000 c.c.s.

Prints are left in this for at least 10 minutes.

Sepia Paper.

This process and the single-solution sensitiser given below may be used for printing from ordinary negatives, but the results are deficient in gradation. Both are excellent for making duplicates of plans, etc., and give a copy in white lines on a brown ground from an ordinary tracing. This copy may be used as a negative for preparing further "positive" copies.

A.—Ferric ammonia citrate (green)	..	..	..	110 grs.	250 gms.
Water	..	..	..	1 oz.	1,000 c.c.s.
B.—Tartaric acid	..	..	..	18 grs.	40 gms.
Water	..	..	..	1 oz.	1,000 c.c.s.
C.—Silver nitrate	..	..	..	45 grs.	100 gms.
Water	..	..	..	1 oz	1,000 c.c.s.

D.—Gelatine	30 gra.	70 gms.
Water .. .	1 oz.	1,000 c.c.s.

Equal parts (say 1 oz. of each) of these solutions are mixed as follows—D is rendered just fluid on a water bath, A and B added, and lastly C, a few drops at a time. The prints are fixed in 1 50 hypo

One-Solution Sepia Sensitiser.

Silver nitrate	55 gra	3 5 gms
Water .. .	4 5 drs	15 20 c.c.s.

Add ammonia drop by drop just to re-dissolve the white precipitate, and then a little sulphuric (or citric) acid just to remove the odour of ammonia. Then add—

Ferric ammonium citrate (green)	40 gra	2 5 gms
Water .. .	6 drs	25 c.c.s.

This solution keeps in the dark, and is used like the four-solution mixture

Pellet Process.

The Pellet process is for copies of line drawings only. From an ordinary tracing it gives a copy in blue lines on a white ground.

A.—Pure gum arabic	4 ozs	200 gms
Water .. .	20 ozs	1 000 c.c.s.
B.—Ferric ammonium citrate	10 ozs	500 gms.
Water	20 ozs	1 000 c.c.s.
C Ferric chloride (crystallised)	10 ozs	500 gms
Water .. .	20 ozs	1 000 c.c.s.

Add 8 vols of B, then 5 vols of C to 20 vols of A, in small doses with constant stirring.

The prints are developed on 10 per cent solution of potass ferrocyanide and "fixed" in 1 25 sulphuric acid (specific gravity 1 84)

The Ferro-Gallic Process.

This process is for line drawings only. It gives a copy, in bluish-black lines on a white ground, from an ordinary tracing.

Gum arabic	60 gra	1 35 gms
Warm water	1 oz	1,000 c.c.s.

When dissolved add the following in the order given—

Tartaric acid .. .	8 gra	18 gms
Salt	36 gra	81 gms.
Ferric sulphate .. .	40 gra.	90 gms.
Ferric chloride .. .	60 gra	135 gms.

The developer for the prints is.—Alum and gallic acid, 1 part of each; water, 80 parts.

MOUNTANTS.

Starch Paste.

Pure starch is mixed with a very small proportion of cold water to form a very stiff mass. It should be so stiff that it is stirred with difficulty. Perfectly boiling water is then poured in about 12 ozs. for every ounce of starch. On stirring, the mixture will jellify without being boiled; but if it does not it is brought to the boil, cooled, the skin taken off, and the paste used on day of making.

Gelatine.

For mounting prints without cockling.

Nelson's No. 1 gelatine	.. 4 ozs.	50 grms.
Water	.. 16 ozs.	200 c.c.s.

Soften the gelatine in the water, liquify on the water bath, and add a little at a time and stirring rapidly -

Methylated spirit	.. 5 ozs.	30 c.c.s.
Glycerine	.. 1 oz.	6 c.c.s.

The mountant is used hot. A piece of ground glass is dipped in hot water, drained, and the mountant brushed over. The print is then laid face up on the pasted surface and rubbed gently in contact with a piece of paper, being then removed and pressed down on its mount.

Dextrine Paste.

Dextrine best white	.. 2½ lbs	1,400 grms
Water at 160 F	.. 80 ozs	2,550 c.c.s
Oil of wintergreen	.. 15 minims	1 c.c.
Oil of cloves	.. 15 minims	1 c.c.

Place the water in a vessel standing in a larger vessel of water kept to within 1° of 160 F. Stir in the dextrine slowly and when it has all dissolved add the two preservative oils, stirring all the time. Then allow to cool pour into bottles, and cork. Put aside in a cool place for a week or two for the mixture to congeal to a firm white smooth paste.

Starch-Gelatine.

A.—Bermuda arrowroot	.. 8 ozs	200 grms.
Water	.. 4 ozs	100 c.c.s
B — Nelson's No. 1 soft gelatine	.. 360 grs	10 grms
Water	.. 64 ozs.	800 c.c.s

The gelatine is first softened in the water and A and B are then mixed together and boiled for a few minutes. To the cold mixture are stirred in—

Methylated spirit	.. 5 ozs.	250 c.c.s.
Carbolic acid (liquid)	.. 25 minims	3 c.c.s.

This is a good cold paste, which sticks and keeps fairly well.

Liquid Gelatine.

Gelatine	1 oz.	100 gms.
Water	6 ozs.	600 c.c.s.
Chloral hydrate	1 oz.	100 gms.

The gelatine is dissolved in the water by aid of heat, and the chloral hydrate added. After digesting for a short time the adhesive liquid is neutralised with a little sodium carbonate solution.

Gum-Dextrine.

Picked white gum arabic ..	$\frac{1}{2}$ oz.	65 gms.
Dextrine	$2\frac{1}{2}$ ozs.	280 gms.
Liquid ammonia	4 drops	50 c.c.s.
Carbolic acid	1 dr.	15 c.c.s.
Water	8 ozs.	1,000 c.c.s.

The gum is powdered in a mortar and mixed intimately with the dextrine, and rubbed with 2 ozs. of water until a smooth mixture is obtained. The remainder of the water is added, and the whole boiled for 10 minutes. The ammonia and carbolic acid are added when cold. This mountant keeps well for months, and is smooth in working and of great adhesiveness.

Shellac Mountant.

A strong solution of shellac in methylated spirit, or, better, rectified spirit, is thinly applied to both mount and print, and the two coated surfaces quickly rubbed into contact. A good method of fixing prints to thin mounts in albums, etc.

Affixing Paper to Metal.

Tragacanth	3 ozs.	60 gms.
Gum arabic	12 ozs.	240 gms.
Water	50 ozs.	1,000 c.c.s.
or—		
Gum arabic	1 oz.	100 gms.
Aluminium sulphate	45 grs.	10 gms.
Water	10 ozs.	1,000 c.c.s.

Mounting on Glass (Opalines).

Nelson's No. 2 soft gelatine ..	2 ozs.	30 gms.
Water	20 ozs.	300 c.c.s.

The gelatine is soaked in the water, and liquefied by standing the vessel in hot water. The solution is thinned down until nearly as thin as water. Print and glass are immersed, removed together, and squeegeed together with flat rubber squeegee.

WORKING UP, COLOURING, ETC., PRINTS.

Lubricant for Burnishing Prints.

Powdered Castile soap	..	..	20 grs.	5 grs.
Alcohol	..	..	10 oss.	1,000 c.c.s.

Encaustic Paste.

Purified beeswax	..	..	..	..	50 parts
Oil of lavender..	..	..	..	..	30 parts
Benzole..	..	..	..	..	30 parts
Gum elemi	..	..	..	..	1 part

BASKETT'S FORMULA.

To the contents of a 2d. tin of Globe polish add 1 oz. best olive oil and 1 oz. terebine. Apply with soft cloth and polish.

Preparing Prints for Colouring.

P.O.P.'s AND GLOSSY BROMIDES.

Rub the prints lightly with a tuft of wool slightly moistened with artist's purified ox-gall. If they have been lubricated before burnishing apply previously a little alcohol in the same way.

COLLODION PRINTS

Fluid extract of quillain	..	..	1 dr	5 c.c.s.
Water	..	..	1 oz	40 c.c.s.
Alcohol	..	..	1 oz.	40 c.c.s.

BROMIDES.

For Water Colouring

Apply ox-gall as directed for P.O.P., or prepare as directed below for pastel work.

For Oil Colouring.

If the surface is clean no preparation is needed, if otherwise give a wash of gum, starch, or gelatine, or prepare with pumice powder. Also light drying oil (from the artists' colourman) may be rubbed over with a tuft of wool or the fingers. It dries in about twenty-four hours, and leaves the surface of the bromide ready for painting.

For working up in pastel or black and white, apply fine pumice powder with a tuft of wool, and remove with another piece of wool or a duster.

Fixative for Crayon and Pastel Work.

A.—Mastic	..	..	..	24 grs.	1.6 gm.
Amyl acetate	..	..	..	3 oss.	85 c.c.s.

Dissolve by agitation, and allow to stand some hours before use.

B.—Celluloid (film clippings free from emulsion will do)	.. ..	7 grs.	0.45 gm.
Amyl acetate	.. ..	3 ozs.	85 c.c.s.

Dissolve by agitation. Mix when both are clear, and keep in tightly-corked bottle. Apply with spray diffuser.

Colouring Prints with Dyes.

Dissolve the aniline colour (1d. packets of dye will do) in a sufficient quantity of water (from $\frac{1}{2}$ to 1 oz. to a 1d. packet), and for glossy prints add a little gum. If the work affects the gloss when finished, rub the print over with a piece of wool slightly moistened with a solution of wax in benzole.

Colouring Prints with Artists' Water Colours.

The following are suitable colours for bromide enlargements, platinum, and carbon prints. The colours in ordinary type are permanent; those in italics are more or less doubtful except under special precautions against exposure. Those marked * are transparent.

*Alizarin Scarlet.	*Prussian Blue.	*Hooker's Green, No. 2.
<i>Flesh Tint, No. 1.</i>	*Brown Pink.	Terre Verte.
<i>Flesh Tint, No. 2.</i>	*Burnt Sienna.	*Brown Madder.
<i>Flesh Tint, No. 3.</i>	Cadmium Yellow.	<i>Payne's Grey.</i>
*Indian Red.	<i>Chrome Lemon</i>	Raw Umber.
*Rose Madder.	<i>Chrome Orange.</i>	Sepia.
Venetian Red.	*Indian Yellow.	*Vandyke Brown.
Vermilion.	Naples Yellow.	Ivory Black.
*Antwerp Blue.	*Raw Sienna.	Lamp Black.
Cobalt Blue.	Roman Ochre.	Chinese White.
*French Ultramarine	Yellow Ochre.	
Indigo.	<i>Emerald Green.</i>	

Colours for Air-brush Work.

The following is a list of the most useful colours for air-brush work:—

Blanc d'Argent, No. 2.	Lamp Black.	Ultramarine, Light.
Burnt Sienna.	Light Red.	.. Middle.
Burnt Umber.	Mauve.	.. Deep.
Charcoal Grey.	Naples Yellow.	Vandyke Brown.
Chinese White.	Neutral Tint.	Vermilion.
Chrome Lemon.	Permanent Crimson.	Yellow Ochre.
Chrome Yellow.	Permanent Green.	Brown Madder.
Chrome Deep.	Permanent Scarlet.	Emerald Oxide of
Chrome Orange.	Prussian Blue.	Chromium
Cologne Earth.	Raw Sienna.	Indian Yellow.
Emerald Green.	Raw Umber.	Sepia.
Indian Red.		

Spotting Bromide Prints.

Mix together Payne's grey and Indian ink (the colour should match that of the film).

Spotting P.O.P. Prints.

Add a little carmine to the above. When mixture is dry (on the palette) work in a strong solution of gum, rubbing the brush one way only, to avoid making air-bells. If the prints are to be enamelled or glazed by stripping after spotting, then artists' oil colours with benzole in which gum dammar has been dissolved, or water colours, may be used with shellac water varnish. (See "Negative Varnishes.")

Colouring from Behind (Crystoleum).

The print (which should be albumen) is mounted with a warm solution of:—

Hard gelatine	..	..	..	20 grs.	45 grs.
Water	..	..	..	1 oz.	1,000 c.c.s.

containing a little salicylic acid to keep it. Or with a cold mountant made by mixing the above with an equal volume of starch paste.

VARNISH FOR "TRANSLUCING."

Canada balsam	..	..	..	5 ozs.	100 grs.
Solid paraffin	..	..	..	2 ozs.	40 grs.
White wax	..	..	..	2 ozs.	40 grs.

which is melted, the picture immersed, and the whole kept as cool as possible consistent with remaining fluid.

COLOUR PHOTOGRAPHY.

The following are the official working instructions for the screen-plates freely in the market at the time of sending this portion of the ALMANAC to press (September 15, 1915):—

The Autochrome Plate.

SIMPLIFIED METHOD OF DEVELOPMENT.

Two solutions only are used—developer (used also for re-development) and reversing solution. There is no need to fix.

Developer—Stock Solution.

A.—Water, distilled	.....	35 ozs.	1,000 c.c.s.
Metotoquinone (Quinomet)	.....	$\frac{1}{2}$ oz.	15 grs.
Soda sulphite, anhydrous	.....	$3\frac{1}{2}$ ozs.	100 grs.
Liquor ammonia, '920	.....	9 drams	32 c.c.s.
Potass. bromide	.....	90 grs.	6 grs.

Dissolve the Quinomet in warm water (about 100° F.), add the sulphite, and then, when cold, the ammonia.

Working developer: Stock solution, above, 1 part; water, 4 parts.

For correct exposure, time of development is 2½ minutes exactly; then rinse and immerse in reversing solution, C below.

Where exposure may not be correct, it is best to develop by the following table, allowing of errors being compensated for.—

For half-plate, place in developing dish

C D.—Stock solution, A above	85 minims	5 c.c.s.
Water	2½ ozs.	80 c.c.s.

Have ready in one measure glass—

Stock solution, A above ...	½ oz	15 c.c.s.
and in another -		

Stock solution, A above ..	1½ ozs	45 c.c.s.
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These are placed near the lamp, one or the other quantity of the developer being quickly added to that in the dish according as the plate comes up quickly or slowly

Immerse the plate in solution C), and count the number of seconds elapsing before the first outlines of the image appear (disregarding the sky) by looking at the plate rapidly without taking it out of the dish. Immediately these outlines are discernible, pour into the dish either 15 c.c.s (½ oz), or 45 c.c.s (1½ oz) of A whichever may be necessary according to the following table (continuing to count the seconds —

Appearance of outlines of image (disregarding sky) after immersion		Quantity of developer A to add on appearance of first outlines	Total duration of development from immersion of plate	
Seconds			Minutes	Seconds.
12 to 14		15 c.c.s. (½ oz)	1	15
15 to 17		do do.	1	45
18 to 21		do do	2	15
22 to 27		do do	3	0
28 to 33		do do.	3	30
34 to 39		do do	4	30
Extreme under exposure)	40 to 47	45 c.c. (1½ ozs)	3	0
)	Above 47	45 c.c. (1½ ozs)	4	0

For a quarter plate use one-half the above quantities.

REVERSING SOLUTION

C.—Potassium permanganate	30 gra.	2 gms.
Sulphuric acid	3 drams	10 c.c.s.
Water	35 ozs	1,000 c.c.s.

This solution will keep for a short time, but should not be used if

Immediately the plate is covered by the C solution daylight may be used. After 3 or 4 minutes, wash for 30 seconds in running water. In summer it is well to put the plate, after leaving the C bath, for 2 minutes into a solution of chrome alum, as follows:—

Chrome alum	150 grs.	10 gms.
Water	35 ozs.	1,000 c.c.s.

The plate should be rinsed before placing in the second developer, or, if desired, it may be dried and re-developed after a day or two.

Second Development.—The plate is then re-developed in full daylight, using the solution which has served for the first development (kept in the dish without special precaution). When the highlights are completely darkened (about 3 or 4 minutes) the plate is washed for 3 or 4 minutes, and immediately placed to dry. Fixing is unnecessary unless the plate is intensified.

PYRO DEVELOPMENT.

The following method, which was that originally advised for the development of Autochrome plates, is still preferred by some workers. The solutions are as follows:—

FIRST DEVELOPMENT.

A.A.—Water	3½ ozs.	100 c.c.s.
Soda bisulphite solution ..	2 drops	2 drops
Pyro	45 grs.	3 gms. *
Potass bromide	45 grs.	3 gms.
B.B.—Water	3 ozs.	85 c.c.s.
Soda sulphite, anhydrous	3 drams.	10 gmv.
Ammonia '920	½ oz.	15 c.c.s.

Working developer —

Water	3½ ozs.	100 c.c.s.
A.A.	3 drams.	10 c.c.s.
B.B.	3 drams.	10 c.c.s.

This developer serves for once only. Time of development (for correct exposure), 2½ minutes exactly at 60° to 65° F.

REVERSING BATH.

C.—As given above, and used as there directed.

SECOND DEVELOPMENT.

D.—Water, distilled	35 ozs.	1,000 c.c.s.
Soda sulphite, anhydrous	½ oz.	15 gms.
Dianol (Diamidophenol)	75 grs.	5 gms.

After a rapid washing, the plate is placed in the Dianol (Diamidophenol) developer D for 3 or 4 minutes. This should be performed in a strong light, and continued until the white portions are completely blackened. Over-development need not be feared.

There is no need for fixing the plate after the second development. It only requires washing, drying, and varnishing.

CONTROLLED DEVELOPMENT WITH PYRO.

Make a quarter-strength pyro solution, viz —

<i>bb</i> Solution B B.....	1 part
Water	3 parts

To make working developer for a half-plate take —

Solution A.A	3 drams.	10 c.c.s.
Solution <i>b b</i>	3 drams.	10 c.c.s.
Water	3 ozs.	80 c.c.s.

And have ready in a small graduated measure $1\frac{1}{2}$ oz (45 c.c.s.) of *b.b.* solution, to be added wholly or partly to the bath during development, if necessary.

As soon as the plate is in the dish, count the number of seconds from the moment of entering until the appearance of the first outlines of the image. The sky, however, should not be taken into consideration.

It is unnecessary to view the plate by the light of the lantern until 20 seconds have elapsed, as whatever be the degree of exposure the first forms will not be seen before 22 seconds.

The number of seconds elapsing before the appearance of the image is the guide to the further development of the plate, which should be carried out according to the following table —

Time of first appearance of image (not counting sky)	Quantity of ammonia solution <i>bb</i> , i.e., diluted to quarter strength, to be added after image appears	Total time of development, including time of appearance.
Seconds	C.c.s.	Minutes Seconds
22 to 24	None	2 0
25 to 27	2	2 15
28 to 30	8	2 30
31 to 35	15	2 30
36 to 41	20	2 30
42 to 48	25	2 30
49 to 55	30	2 45
56 to 64	35	3 0
65 to 75	40	4 0
over 75	45	5 0

The additional quantity of *bb* solution must be added when the outlines begin to appear.

We see by the above that, for example, when the image takes 28 seconds to appear we add 8 c.c.s. of *bb* solution and continue development until the expiration of 2 minutes 30 seconds from the time the plate was put in the dish.

INTENSIFICATION.

If, after the second development, the plate does not show sufficient contrast and brilliancy, it may be much improved by intensification.

This operation may take place at the time of development or be delayed, if desired, till a later time.

Whichever plan is followed, all traces of the developer must be first destroyed by the following operation:—

OXIDATION.

Immerse the plate for 10 or 15 seconds (after a wash of similar duration) in solution E, composed of:—

E. Water	35 ozs.	1,000 c.c.s.
Solution C (Acid Permanganate) ..	5 drams	20 c.c.s.

which oxidises any traces of developer remaining in the coating, and allows proper intensification. Then wash the plate for a few seconds in running water.

For intensification prepare the two following solutions:—

F. Distilled water	35 ozs.	1,000 c.c.s.
Pyrogalllic acid	45 grs.	3 gms.
Citric acid	45 grs.	3 gms.
G Distilled water	3½ ozs.	100 c.c.s.
Nitrate of silver	75 grs.	5 gms.

For use take:—

Solution F	3½ ozs.	100 c.c.s.
Solution G	3 drams	10 c.c.s.

Immerse the plate in this solution and examine from time to time the increase of intensity. The solution turns yellow little by little, and eventually becomes turbid. It should be used as quickly as possible, and rejected when turbidity makes its appearance.

Usually intensification is complete before this state is reached, but should it be necessary to continue intensification, fresh solution should be used after a short wash, a few seconds in the oxidising solution (F), and another short wash.

During intensification the whites of the plate may become yellowish (dichroic fog). All traces of this disappear in the following clearing bath.

CLEARING.

After intensification, wash the plate for a few seconds and place in the following solution (H) of permanganate, containing no acid. Allow this to act from 30 seconds to 1 minute:—

H. Water	35 ozs.	1,000 c.c.s.
Potass. permanganate	15 grs.	1 gm.

Particular care should be exercised that Solution C (Acid permanganate) be not mistaken for Solution H (Neutral permanganate).

FIXING.

After a short wash, fix for about 2 minutes in an acid hyposulphite bath made as follows:—

I. Water	35 ozs.	1,000 c.c.
Hypo	5½ ozs.	150 gms.
Soda bisulphite, saturated solution	1½ ozs.	50 c.c.s.

The density of the image should not be reduced by fixing. Should reduction be found, it is caused either by too short second development or exposure to too weak a light during second development. Fixing is indispensable when the plate has been intensified.

WASHING.

A wash for 4 to 5 minutes is sufficient to clear the extremely thin gelatine coating of traces of hyposulphite. The plate is then put to dry. It may be that the whites of the subject still retain a slight yellowish tinge. If so, treatment by Neutral Permanganate (solution H) followed by use of the fixing bath I may be repeated.

The Omnicolore Plate

The instructions and formulæ are those given above for the Autochrome, the same emulsion being used for both plates.

The Dufay (Diophtichrome) Plate.

FIRST DEVELOPMENT

The following developer is recommended to the exclusion of all other formula —

Water	35 ozs.	1,000 c.c.s.
Metol	90 grs.	6 gms.
Sulphite of soda recrystallised	2½ ozs.	75 gms.
Hydroquinone	30 grs.	2 gms.
Potass bromide.. . . .	30 grs.	2 gms.
Ammonia 880	3½ drams	12 c.c.s.

(Ammonia at 880 being volatile and liable to loss, it is a convenient practice to dilute it on receipt with an equal bulk of distilled water, and then use double the quantity indicated above.)

For use take equal parts of the above developer and of water. This developer is adapted for automatic development, giving images with full detail and the maximum of intensity. The time of development at 60° F. should be 4 to 5 minutes. Fresh solution should be taken for each plate developed. The development should be begun in as nearly complete obscurity as possible. In about a minute after immersion in the developer it is permissible to examine the plate by a green safe light. Red light is in no case to be used, and it is advisable to expose the plates to the green light as little as possible. When the image is sufficiently developed, wash for about 20 seconds in running water, then place in the reversing solution.

REVERSING SOLUTION

Water	35 ozs.	1,000 c.c.s.
Potass bichromate .. .	75 grs.	5 gms.
Sulphuric acid	170 minims	10 c.c.s.

Immediately the plate is covered with this solution admit daylight to the dark room or take the dish to an open door or well-lit window, as the rest of the operations should take place in full daylight. The reduced silver will gradually dissolve in the bichromate solution; the progress of the reversal and the appearance of the real colours may be seen on looking through the plate. When the

reversal is complete, which occupies about two minutes, wash in running water till the yellow stain, due to the bichromate, disappears.

SECOND DEVELOPMENT.

Then commence the second development by replacing the plate in the developer previously used for the first development. The image when it left the reversing solution consisted of a positive image in white silver bromide, which is reduced to a black deposit of silver by the action of the developer and daylight, or, failing that, of strong artificial light. The second development should be continued till the darkening action is complete, which will be in about 3 or 4 minutes in daylight.

FINAL WASHING.

Three or four minutes' washing in running water is sufficient although a longer time is not harmful.

INTENSIFICATION.

If over-exposed, the image appears too quickly on the first development, the ultimate result being a thin image with a washed-out appearance. This result may be improved to a certain extent by intensification. Bleach thoroughly in:—

Water	20 ozs.	800 c.c.s.
Alcohol	5 ozs.	200 c.c.s.
Bichloride of mercury.....	1 oz.	40 gms.

Then wash for 5 minutes and blacken in the following solution:—

Water	10 ozs.	100 c.c.s.
Soda sulphite, recryst.	1 oz.	10 gms.

The Paget Plate.

DUPLICATING METHOD.

A separate panchromatic plate is exposed behind and in contact with a mosaic three-colour taking screen, developed, fixed, washed and dried. From it a positive transparency is printed by contact. The transparency is then bound up in register with a mosaic three colour viewing screen.

EXPOSURE.

The following particulars are given as a rough guide.

Open landscape, in good light with sunshine, stop $f/8$, cap off and on, or about $\frac{1}{2}$ of a second.

Portraiture, head and shoulders only; in diffused light out of doors, stop $f/8$, about 3 seconds.

Instantaneous exposures should not be attempted except in the brightest light, and never with a smaller stop than $f/6.5$, under which conditions the exposure may be about $\frac{1}{100}$ th of a second.

Actinometers are a reliable means of calculating the exposure, and the following speed numbers will be found correct:—

Watkins	Wynne
15	F24

These numbers represent the speed of the panchromatic plate with filter and taking screen in position ready for exposure.

DEVELOPMENT OF NEGATIVE.

Most developers may be used, provided the resulting negative be clean and soft. The best results are obtained with Rodinal, 1 in 30, and development should be complete in 2 minutes.

Unless a green safelight is used development must take place in total darkness. On no account should a red light or one of any colour other than the safe green be used. Development in total darkness presents no difficulty, as if the exposure given is about right, the time of development with Rodinal as given above will be correct.

Rinse the plate and fix in the following bath:—

Hypo	..	..	..	..	..	6 ozs.
Potass. metabisulphite	..	..	..	..	..	$\frac{1}{2}$ oz.
Water	..	..	..	..	..	20 ozs.

Wash again for about 15 minutes, and put to dry.

MAKING THE TRANSPARENCY.

To obtain the best results the following conditions must be observed:—The transparency should be of black tone, perfectly clear, and free from fog, brilliant and full of detail. These conditions can be secured by using the special transparency plates and developer issued in connection with the process.

REGISTERING TRANSPARENCY WITH VIEWING SCREEN.

Standing well back in the room, facing the light, the operator holds the two plates together, film to film, the screen being towards him. The latter is then moved very slightly in a circular direction (the transparency being held rigid) until small squares are seen. The same circular direction being maintained the squares will grow larger until they disappear and patches of colour take their place. Continue the movement until a perfectly even tint (it does not matter of what colour) appears all over the transparency. The squares of the screen are now parallel with those of the transparency, and the slightest movement of the screen one way will give the picture in its correct colours. To determine the right direction the operator, still holding the screen and transparency tightly together, should turn them in a slanting position, viewing them from either the top, bottom, right or left, when from one of these points the correct colours will be seen. The screen should be moved very gently in this direction, when the proper colours will gradually appear. Clip the two together with a couple of bull-dog paper clips and bind them securely.

Binding must be carefully done, so as not to alter the position of the screen. Denison's binding strips will be found the best. Bind the two sides not clipped and see that the binding strip is adhering everywhere; then remove one clip at a time (the transparency should never be without one clip) and clip the sides already bound before binding the remaining two. Leave the clips in position until the binding is perfectly dry.

The viewing screens will register one way only, always lengthways of the plate. Therefore, if it is desired to take a portion of the picture from a large negative, say a quarter plate size from a half plate

negative, the quarter plate transparency must be made lengthways of the negative and not across.

In the case of square out plates such as $3\frac{1}{2} \times 3\frac{1}{2}$ a line will be found on the edge of the viewing screen showing the "lengthways" of the plate.

MISCELLANEOUS FORMULÆ.

Reversed Negatives by Ammonium Persulphate.

A lantern or other thinly coated slow plate is placed in contact with the negative in a printing frame and a full exposure given such as would be thought advisable in making a soft positive transparency. The plate is developed with a clean working developer (e.g., glycin) until the shadows appear quite black on the glass side of the plate. The time of development may be five times as long as for an ordinary transparency. The latter is then washed and placed in a 2 per cent. solution of ammonium persulphate until the silver image is seen to be removed. The plate is then thoroughly washed and developed in any clean developer containing about half a grain of bromide per ounce. It is then fixed and washed and dried. After the first development the operations may be done in weak daylight or artificial light. The action of the persulphate should be as complete as possible, otherwise a veil is left over the negative. The above is a very rapid and economical process. Direct positives, but reversed from right to left, from engravings, etc., may be made in the camera by substituting bromide paper for the plate. The exposure should be full and the development as above. The method has this advantage, that the lines are rendered in the same degrees of black and grey as in the original, a point of some importance, since the lines in an engraving are seldom, if ever, of uniform blackness.

To Recover Fogged (Sensitive) Dry-Plates.

Soak for 15 minutes in the following bath, contained in a porcelain tank:—

Potass. bichromate	..	..	$\frac{1}{2}$ oz.	12.5 gms.
Ammonium bromide	..	..	$\frac{1}{2}$ oz.	12.5 gms.
Water	..	..	20 ozs.	1,000 c.c.s.

Wash for 30 minutes, wipe with a pad of cotton wool and stand aside—of course in the dark or by deep ruby light—to dry.

Backing Dry Plates.

Gum solution (ordinary office gum)	1 oz.	100 c.c.s.
Caramel	1 oz.	100 gms.
Burnt sienna, ground in water	2 oss.	200 gms.

Mix and add—

Alcohol	2 oss (fl.)	200 c.c.s.
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BACKING SHEETS FOR DRY PLATES.

Gelatine	1 part	50 gms.
Water	2 parts	100 c.c.s.
Glycerine	1 part	50 c.c.s.
Indian ink	A small addition.	

Make a paste, and coat strong paper; place the prepared material face downwards on waxed glass to set. Press to back of plate before putting into dark slide.

The Dusting-on Process.

Best gum arabic	80 grs.	5 2 gms.
White sugar	60 grs.	4 0 gms.
Ammonium bichromate	60 grs.	4 0 gms.
Water	7 oss.	200 c.c.s.
Methylated spirit	1 oz.	30 c.c.s.

This mixture will keep for a few days only, and after the plate has been coated and exposed it is developed with finest graphite powder, collodionized, and washed.

Ink for Rubber Stamps.

Aniline red (violet)	900 grs.	210 gms.
Boiling distilled water	10 oz.	1,000 c.c.s.
Glycerine	about $\frac{1}{2}$ oz.	60 c.c.s.
Treacle	about $\frac{1}{2}$ oz.	30 c.c.s.

Invisible Ink.

Chloride of cobalt	25 grs.	60 gms.
Distilled water	1 oz. (fl.)	1,000 c.c.s.

Writing executed with this ink is first pink on paper, becoming invisible on drying. On warming the writing turns blue.

Dead Black for Wood.

Borax	30 grs.	8 gms.
Glycerine	30 minims	8 c.c.s.
Shellac	60 grs.	16 gms.
Water	8 oss.	1,000 c.c.s.

Boil till dissolved and add —

Nigrosine, W.S.	60 grs.	16 gms.
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Or paint the wood first with—

Cupric chloride	75 grs.	75 grms.
Potass. bichromate	75 grs.	75 grms.
Water	2½ ozs.	1,000 c.c.s.

and as soon as the surface dries apply—

Aniline hydrochloride	150 grs.	150 grms.
Water	2½ ozs.	1,000 c.c.s.

and wipe off any yellow powder that forms Repeat the process till black enough, and then rub over with boiled linseed oil.

Waterproofing Solution for Wood.

Asphalt	4 ozs.	400 grms.
Pure rubber	30 grs.	6 grms.
Mineral naphtha	10 ozs.	1,000 c.c.s.

Apply with a stiff brush and give three successive coats, allowing to dry between each The vapour from this solution is very inflammable.

Polish for Cameras, Woodwork, etc.

Linseed oil	20 ozs	400 c.c.s.
Spirits of camphor	2 ozs.	40 c.c.s.
Vinegar	4 ozs	80 c.c.s.
Butter of antimony	1 oz	20 grms
Liquid ammonia	½ oz.	5 c.c.s.
Water	½ oz.	5 c.c.s.

This mixture is applied very sparingly with a bit of old flannel, and thoroughly rubbed off with soft rags.

Blackening Brass Work.

Copper nitrate	200 grs	450 grms.
Water	1 oz.	1,000 c.c.s.

Place the brass work (perfectly cleaned) in the solution for a few moments, heating it on removal.

Varnish for Brass Work.

Celluloid	10 grs.	4 grms.
Amyl alcohol	½ oz.	100 c.c.s.
Acetone	½ oz.	100 c.c.s.

Instead of this cold celluloid varnish, commercial "cold lacquer" may be used.

To Blacken Aluminium.

Clean the metal thoroughly with fine emery powder, wash well, and immerse in—

Ferrous sulphate	1 oz.	80 gms.
White arsenic	1 oz.	80 gms.
Hydrochloric acid	12 ozs.	1,000 c.c.s.

Dissolve and add—

Water	12 ozs.	1,000 c.c.s.
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When the colour is deep enough dry off with fine sawdust, and lacquer.

Silvering Mirrors (Martin's Method).

(In employing the following formula, it should be well understood that the glass plate to be silvered must be scrupulously clean.)

A.—Nitrate of silver	175 grs.	40 gms.
Distilled water	10 ozs.	1,000 c.c.s.
B.—Nitrate of ammonium	262 grs.	60 gms.
Distilled water	10 ozs.	1,000 c.c.s.
C.—Pure caustic potash	1 oz.	100 gms.
Distilled water	10 ozs.	1,000 c.c.s.
D.—Pure sugar candy	$\frac{1}{2}$ oz. (avoir.)	100 gms.
Distilled water	5 ozs.	1,000 c.c.s.

Dissolve and add—

Tartaric acid	50 grs.	23 gms.
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Boil in flask for ten minutes, and when cool add—

Alcohol	1 oz.	200 c.c.s.
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Distilled water, *quant. suff.* to make up to 10 ozs. or 2,000 c.c.s.

For use take equal parts of A and B. Mix together also equal parts of C and D, and mix in another measure. Then mix both these mixtures together in the silvering vessel, and suspend the mirror face downwards in the solution.

MISCELLANEOUS INFORMATION.

List of the Principal Works on Photography.

[The books mentioned below are obtainable by order of all photographic dealers.]

ELEMENTARY AND GENERAL TEXT-BOOKS.

- Amateur Photography.* By F. T. Beeson and A. Williams. 1s.
Elementary Photography. By John A. Hodges. 1s.
Iford Manual of Photography. By C. H. Bothamley. 1s.
Sinclair Handbook of Photography. 1s.
Barnet Book of Photography. 1s. 6d.
A Primer of Photography. By Captain Owen Wheeler. 2s. 6d.
Early Work in Photography. By W. Ethelbert Henry. 1s.
Hand-Camera Photography. By Walter Kilbey. 1s.
Photography in a Nutshell. By the Kernel. 1s.
Photographic Reference Book. By J. McIntosh. 1s. 6d.
The Science and Practice of Photography. By Chapman Jones. 5s.
Instruction in Photography. By Sir William Abney. 11th Edition.
 Revised and enlarged. 7s. 6d.
Dictionary of Photography. By E. J. Wall. 7s. 6d.
Cyclopædia of Photography. Edited by Bernard E. Jones. 10s.
The Complete Photographer. By R. Child Bayley. 10s. 6d.
Photography. By Alfred Watkins. 6s.
Photography in Principle and Practice. By S. E. Bottomley. 3s. 6d.
Photography of To-day. By H. Chapman Jones. 5s.

COPYRIGHT AND PRESS PHOTOGRAPHY.

- Photographic Copyright.* By George E. Brown, F.I.C., and Alexander Mackie. 1s.
Photographs for the Papers. By John Everard. 1s.

PHOTOGRAPHIC OPTICS AND CHEMISTRY.

- Photographic Lenses: How to Choose and How to Use.* By John A. Hodges. 2s.

- Photographic Lenses.* By Conrad Beck and Herbert Andrews. 1s.
The Lens. By Thos. Bolas and George E. Brown. 2s. 6d.
The Optics of Photography and Photographic Lenses. By J. Traill Taylor. 3s. 6d.
System of Applied Optics. By H. Dennis Taylor. 30s.
Photographic Optics, a Treatise on. By R. S. Coles. 6s.
Photographic Optics. By Otto Lummer. Translated by Silvanus Thompson. 6s.
First Book of the Lens. By C. Welborne Piper. 2s. 6d.
Telephotography. By T. R. Dallmeyer. 21s.
Modern Telephotography. By Captain Owen Wheeler. 1s. 6d.
Practical Telephotography. (No. 90 of "The Photo-Miniature.")
Lens work for Amateurs. By Henry Orford. 3s.
Tables of Conjugate Foci. By J. R. Gotz. 6d.
Chemistry for Photographers. By Charles F. Townsend, F.C.S. 1s.
The Chemistry of Photography. By R. Meldola. 6s.
Investigations on the Photographic Processes. By S. E. Sheppard, D.Sc., and C. E. Kenneth Mees, D.Sc. 6s. 6d.

ART, PORTRAITURE, HAND-CAMERA WORK, ETC.

- Posing the Figure* (No. 136 of "The Photo-Miniature")
Lighting in Portraiture (No. 137 of "The Photo-Miniature.")
Picture-making by Photography. By H. P. Robinson. 2s. 6d.
Photography on Tour. 6d.
Correct Exposure. (No. 105 of "The Photo-Miniature.")
Practical Landscape Photography. By G. T. Harris. 1s.
The Photographic Studio. A guide to its construction, etc. By T Bolas. 2s.
Lighting in Photographic Studios By P. O. Duchocquois.
 Revised, with additional matter, by W. Ethelbert Henry, O.E. 1s.
The Studio, and what to do in it. By H. P. Robinson 2s. 6d.
Practical Professional Photography. Vols I and II By C. H Hewitt. 1s. per vol.
Magnesium Light Photography. By F. J. Mortimer. 1s
Hand-Cameras. By R. Child Bayley. 1s. 6d.
Hand-Camera Work. (No. 107 of "The Photo-Miniature.")
Reflex Cameras. (No. 99 of "The Photo-Miniature.")
Photography of Moving Objects and Hand-camera Work for Advanced Workers. By Adolphe Abrahams 1s
Instantaneous Photography. By Sir William Abney. 1s.
Copying Methods. (No. 41 of "The Photo-Miniature.")
Panoramic Photography. (No. 73 of "The Photo-Miniature.")
Stereoscopes and Stereoscopic Photography. From the French of F. Drouin. 2s.
Stereoscopic Photography. (No. 98 of "The Photo-Miniature.")
Photo-micrography. By E. J. Spitta. 12s.

Handbook of Photo-micrography. By H. Lloyd Hind and W. Brough Bantles. 7s 6d.

NEGATIVE PROCESSES.

Wet-collodion Photography. By Charles W. Gamble. 1s.

The Wet Collodion Process. By Arthur Payne. 3s.

Collodion Emulsion. By H. O. Klein. 5s.

Practical Orthochromatic Photography. By Arthur Payne. 1s.

The Photography of Coloured Objects By C. E. Kenneth Mees, D.Sc. 1s.

Negative-making. By Sir William Abney, F.R.S. 1s

The Watkins Manual (of exposure and development). By Alfred Watkins 1s.

Photography by Rule By J. Sterry. 1s.

Finishing the Negative Edited by H. Snowden Ward. 1s.

Retouching By Arthur Whiting. 1s.

Art of Retouching. By J. Hubert. 1s.

Art of Retouching Negatives, and Finishing and Colouring Photographs. By T. S. Bruce and Alfred Braithwaite. 2s. 6d.

PRINTING PROCESSES.

Photographic and Photo-mechanical Printing Processes. By W. K. Burton. 4s

Art and Practice of Silver Printing. By Sir William Abney and H. P. Robinson. 2s. 6d.

Bromide Enlarging and Contact Printing. By S. Herbert Fry. 6d.

Toning Bromide Prints. By R. Blake Smith. 1s.

Toning Bromides. By C. W. Somerville. 1s.

Toning Bromide and Gaslight Prints. (No. 103 of "The Photo-Miniature.")

Photographic Enlarging. By R. Child Bayley. 1s. 6d.

Photographic Enlargements. How to Make Them. By Geo. Wheeler. 1s.

A B C Guide to Autotype Permanent Photography. By J. B. Sawyer, 1s.

Carbon Printing. By E. J. Wall. 1s.

Orobrome, Science and Practice. By Thomas Manly. 1s.

Photo-aquatint, or Gum Bichromate Process. By Alfred Maskell and R. Demachy. 1s.

Oil and Bromoil Printing. (No. 106 of "The Photo-Miniature.")

Platotype Printing. By A. Horsley Hinton. 1s.

Photographic Reproduction Processes. By P. C. Duchocqois. A treatise on photographic impressions without silver salts. 2s. 6d.

Photo-ceramics. By W. Ethelbert Henry, C.E., and H. Snowden Ward. 1s. 6d.

Trimming, Mounting, and Framing. (No. 102 of "The Photo-Miniature.")

LANTERNS AND LANTERN SLIDES: CINEMATOGRAPH.

- Modern Magic Lanterns.* By R. Child Bayley. 1s.
The Lantern, and How to Use It. By Goodwin Norton. 1s.
Optical Projection. By Lewis Wright. 6s.
The Optical Lantern: for Instruction and Amusement. By Andrew Pringle. 2s. 6d.
Practical Slide-making. By G. T. Harris. 1s.
Colouring Lantern Slides. (No. 83 of "The Photo-Miniature.")
Living Pictures. By H. V. Hopwood. 2s. 6d.
Animated Photography. By Cecil M. Hepworth. 1s.
The Handbook of Kinematography. By Colin N. Bennett. 5s.
The Modern Bioscope Operator. 1s. 6d.

PROTO-MECHANICAL PROCESSES, ETC.

- Horgan's Half-tone and Photo-mechanical Processes.* By S. H. Horgan. 12s. 6d.
Half-tone Process, The. By Julius Verfassser. 5s.
Half-tone Process on the American Basis. By Wm. Cronenberg. 2s.
A Treatise on Photogravure in Intaglio. By the Talbot Klic process. By Herbert Denison. 4s. 6d.
Photo-Mechanical Processes. By W. T. Wilkinson. 4s.
Photo-aquatint and Photogravure. By Thomas Huson. 2s.
Practical Radiography. A handbook of the applications of the X-rays. By A. W. Isenthal and H. Snowden Ward. 6s.

COLOUR PHOTOGRAPHY.

- Photography in Colours.* By Dr. Lindsay Johnson. 3s. 6d.
Photography in Colours. By Bolas, Tallent and Senior. 1s. 6d.
Three-colour Photography. By Baron von Hübl. Translated by H. O. Klein. 7s. 6d.
Natural-colour Photography. By Dr. E. König. Translated by E. J. Wall. 2s.

COPYRIGHT IN PHOTOGRAPHS.

The law of the reproduction of photographs is now governed by the Copyright Act, 1911, which came into force in Great Britain and in some minor British Protectorates on July 1, 1912.

The Copyright (Works of Art) Act, 1862, given in previous editions of the "Almanac," is repealed with the exception of Sections 7 and 8.

The new Act provides protection for all classes of work, both literary and artistic, and is, therefore, a lengthy one, but the chief provisions as to photographs are given below. For a full and adequate, yet simple, treatment of the subject, as far as possible in non-legal language, the reader is referred to "Photographic

Copyright," written by the Editor of this Almanac in conjunction with Alexander Mackie, hon. secretary of the Professional Photographers' Association, and published by Messrs. H. Greenwood and Co., Ltd., 24, Wellington Street, Strand, London, W.C., price 1s. net; post free, in and abroad, 1s. 2d.

Copyright in a photograph lasts for fifty years from the making of the negative.

Registration of copyright is abolished

The copyright belongs to the author unless first made "to the order" of some other person for a valuable consideration, in which case it belongs to the person giving the order.

All assignments of copyright must be in writing.

Photographers can obtain civil remedies (damages, injunctions, etc.) for infringement of copyright; or, where infringement is shown to have been done knowingly, summary remedies (fines and imprisonment) against the infringer.

Infringing copies may be prevented from importation into the United Kingdom by notice to the Customs Commissioners.

Existing copyright photographs (made before July 1, 1912) obtain the full protection of copyright granted by the 1911 Act. They obtain this whether registered or not under the old Act.

The Act provides for copyright in cinematograph films, and permits photographs to be taken of copyright architectural works of art (buildings); and also of sculpture which is situated in a public place. Such photographing is not an infringement of the copyright in the architecture or sculpture.

In accordance with certain unrevoked clauses of the Copyright Act of 1862 it is an offence against the photographer for his work to be fraudulently issued with a false name or marking, or to be exhibited or sold falsely marked. Copies of photographs may not be issued as having been made by the original author, and a photograph in which unauthorised alterations have been made must not be issued as the unaltered work of the author.

REPRODUCTION FEES.

The Copyright Union has drawn attention to the following suggestions, drawn up for the guidance of its members, by Mr. Alfred Ellis:—

Members are advised not to give permission for their copyright photographs to be reproduced until they have full particulars of the size and style of the proposed reproduction, when they can formulate their charges accordingly. For example: a newspaper should pay a fee of not less than 10s. 6d. for half tone black-and-white reproduction not exceeding 6 by 4 ins., when printed with letterpress in one issue of a newspaper; but if it is to be printed as an inset the fee should be at least one guinea. If printed in colours, colotype, or photogravure, it should be a still higher fee. If a photograph is to be reproduced for advertising purposes, a higher fee should be charged than for newspaper work. In all cases the permission must be in writing, and should state the fee to be paid, the process by which the photograph is to be reproduced, and whether in black-and-white or colours, the size limit, and the purpose for which the reproduction may be used.

TABLES.

WEIGHTS AND MEASURES.

The formulæ in the editorial pages of this ALMANAC are given, in almost all cases, in both British and metric measures, and in adopting this course we have had the desire to impress upon photographers the simplicity and facility of the latter system. As a rule, the British formulæ are expressed in grains or ounces per 20 ozs of solution, and the metric formulæ in grammes per 1000 c.c.s. In regard to the total bulk of solution, our formulæ are mostly drawn up on the basis that the total bulk after the solution of the solids is that stated in the formula—20 ozs or 1000 c.c.s. as a rule.

The question of a 10 per cent. solution is a point in formulæ making and using which has caused endless discussion, but it is really simple enough if it be borne in mind that the ounce avoirdupois contains 437½ grains, while the fluid ounce contains 480 minims. As 10 per cent. solutions, being strong, are usually measured out in minims, the ounce avoirdupois must be dissolved in enough water to make a solution containing 1 grain in 10 minims, that is to say, 437½ minims, or practically 9 ounces, is the proper bulk for the solution of 1 ounce avoirdupois. But if a solution is to be measured out in fluid ounces, then the 10 per cent. solution will be 1 oz. in 10 fluid ozs.

Throughout this work "grains per ounce" are converted into "grammes per litre" by multiplying by 23. Ounces per any given number of fluid ounces are converted by taking the same ratio of grammes to 1000 c.c.s.

In reference to the names of chemicals, "sodium carbonate" and "sodium sulphite" are used for the crystallised forms of these substances. If the "dry" ("anhydrous") forms are meant, one or other of these terms is used in qualification.

FLUID MEASURE.

1 Cubic centimetre* (c.c.) (1/1000th litre) = 16.9 minims

1 Litre (1 L.) = 35 ozs. 94 m. = 16894.1 minims

Conversion of Metric into British Measures.

GMS. PER LITRE INTO GRAINS PER 10* OZS.

The following table gives the most convenient means of translating metric formulæ into British measures.

* The figures given in Columns 2, 4, and 6 are a correct translation of the metric proportion when the solution is measured out in ounces and fractions of an ounce. If to be measured in minims, the quantities in Columns 2, 4, and 6 are dissolved in 9 ozs. 2 drs. of water.

1	2	3	4	5	6	
Gms. Per Litre	Grs. Per 10† ozs.	Gms. Per Litre	Grs. Ozs. Grs. Per 10† ozs.	Gms. Per Litre.	Grs. Ozs. Grs. Per 10† ozs.	
1	4.4	30	131	$\frac{1}{2}$ -22	678	$1\frac{1}{2}$ -22
2	8.8	35	153	$\frac{1}{2}$ -44	700	$1\frac{1}{2}$ -44
3	13.1	40	175	$\frac{1}{2}$ -66	722	$1\frac{1}{2}$ -66
4	17.5	45	197	$\frac{1}{2}$ -88	744	$1\frac{1}{2}$ -88
5	21.9	50	219	$\frac{1}{2}$ -0	766	$1\frac{1}{2}$ -0
6	26.2	55	241	$\frac{1}{2}$ -22	788	$1\frac{1}{2}$ -22
7	30.6	60	262	$\frac{1}{2}$ -43	809	$1\frac{1}{2}$ -43
8	35.0	65	284	$\frac{1}{2}$ -65	831	$1\frac{1}{2}$ -65
9	39.4	70	306	$\frac{1}{2}$ -87	853	$1\frac{1}{2}$ -87
10	43.8	75	328	$\frac{1}{2}$ -0	875	2
11	48.1	80	350	$\frac{1}{2}$ -22	898	$2\frac{1}{2}$
12	52.5	85	371	$\frac{1}{2}$ -43	920	$2\frac{1}{2}$
13	56.9	90	393	$\frac{1}{2}$ -65	942	$2\frac{1}{2}$
14	61.2	95	415	$\frac{1}{2}$ -87	964	3
15	65.6	100	437	1-0	986	$3\frac{1}{2}$
16	70.0	105	459	1-22	1,008	$3\frac{1}{2}$
17	74.4	110	481	1-44	1,030	$3\frac{1}{2}$
18	78.8	115	503	1-66	1,052	4
19	83.1	120	525	1-88	1,074	$4\frac{1}{2}$
20	87.5	125	547	1-0	1,096	$4\frac{1}{2}$
21	91.9	130	569	1-22	1,118	$4\frac{1}{2}$
22	96.2	135	591	1-44	1,140	5
23	100.6	140	613	1-66	1,162	$5\frac{1}{2}$
24	105.0	145	634	1-87	1,184	$5\frac{1}{2}$
25	109.4	150	656	1-0	1,206	$5\frac{1}{2}$

† N.B.—Quantities in Columns 2, 4, and 6 are dissolved in 9 ozs 2 drs. when solutions are to be measured out in minims.

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* Millilitre and C.C.—Revisions of metric standards have shown that the litre is not exactly 1000 c.c.s., but 999.84 c.c.s. (according to Mendeleef's calculations from the experimental data). The difference appears sufficiently serious in official circles to warrant the abandonment of the term "cubic centimetre," and the employment of "millilitre" for the true thousandth part; millilitre to be abbreviated to "mil." On grounds of terminology there is some reason for this, but until "millilitre" commences to oust c.c. from current writings we shall continue to use the latter term. As regards error, the difference is absolutely negligible, not more than 4 drops in 35 ozs.

GRAMMES INTO GRAINS AND OUNCES (AVOIRDUPOIS).

Gms.	Ozs.	Grs.	Gms.	Ozs.	Grs.	Gms.	Ozs.	Grs.
0.1		1.5	16	$\frac{1}{2}$	28.1	130	$4\frac{1}{2}$	37
0.2		3.1	17	$\frac{1}{2}$	43.5	140	$4\frac{1}{2}$	82
0.3		4.6	18	$\frac{1}{2}$	59.0	150	$5\frac{1}{2}$	18
0.4		6.2	19	$\frac{1}{2}$	74.4	160	$5\frac{1}{2}$	61
0.5		7.7	20	$\frac{1}{2}$	89.8	170	6	0
0.6		9.1	25	$\frac{1}{2}$	57.0	175	6	76
0.7		10.8	30	1	25	180	$6\frac{1}{2}$	44
0.8		12.4	35	1	103	190	$6\frac{1}{2}$	88
0.9		13.9	40	$1\frac{1}{2}$	71	200	7	24
1		15.4	45	$1\frac{1}{2}$	38	250	$8\frac{1}{2}$	32
2		30.9	50	$1\frac{1}{2}$	6	300	$10\frac{1}{2}$	31
3		46.3	55	$1\frac{1}{2}$	83	350	$12\frac{1}{2}$	41
4		61.7	60	2	51	400	14	50
5		77.2	65	$2\frac{1}{2}$	19	450	$15\frac{1}{2}$	52
6		92.6	70	$2\frac{1}{2}$	94	500	$17\frac{1}{2}$	61
7		108.0	75	$2\frac{1}{2}$	64	550	$19\frac{1}{2}$	66
8	$\frac{1}{2}$	14.1	80	$2\frac{1}{2}$	32	600	21	70
9	$\frac{1}{2}$	29.5	85	3	0	650	$22\frac{1}{2}$	72
10	$\frac{1}{2}$	44.9	90	3	76	700	$24\frac{1}{2}$	81
11	$\frac{1}{2}$	60.4	95	$3\frac{1}{2}$	44	750	$26\frac{1}{2}$	91
12	$\frac{1}{2}$	75.8	100	$3\frac{1}{2}$	11	800	28	95
13	$\frac{1}{2}$	91.2	110	$3\frac{1}{2}$	56	850	$29\frac{1}{2}$	102
14	$\frac{1}{2}$	106.7	120	4	102	900	$31\frac{1}{2}$	106
15	$\frac{1}{2}$	12.7	125	$4\frac{1}{2}$	70	1000	$35\frac{1}{2}$	11

Note.—In the above table the British equivalents are given in the form most convenient for actual work, viz, in even ounces and quarter ounces, with odd grains over. If calculations need to be made, the following figures giving the equivalents of ounces and quarter-ounces in grains will be found useful :—

$\frac{1}{2}$ oz. = 109 grs.	$1\frac{1}{2}$ oz. = 765 grs.	$3\frac{1}{2}$ oz. = 1,421 grs.	$4\frac{1}{2}$ oz. = 2,078 grs.
$\frac{1}{4}$ oz. = 219 grs.	2 oz. = 875 grs.	$3\frac{3}{4}$ oz. = 1,531 grs.	$5\frac{1}{2}$ oz. = 2,296 grs.
oz. = 328 grs.	$2\frac{1}{4}$ oz. = 984 grs.	$3\frac{1}{4}$ oz. = 1,640 grs.	$5\frac{3}{4}$ oz. = 2,406 grs.
$\frac{1}{2}$ oz. = 437 grs.	$2\frac{1}{2}$ oz. = 1,094 grs.	4 oz. = 1,750 grs.	6 oz. = 2,625 grs.
$\frac{3}{4}$ oz. = 546 grs.	$2\frac{3}{4}$ oz. = 1,203 grs.	$4\frac{1}{4}$ oz. = 1,859 grs.	$6\frac{1}{4}$ oz. = 2,734 grs.
$\frac{1}{8}$ oz. = 656 grs.	3 oz. = 1,312 grs.	$4\frac{3}{4}$ oz. = 1,969 grs.	$6\frac{3}{4}$ oz. = 2,844 grs.

C.C.S. INTO MINIMS AND OUNCES (FLUID).

C.c.s.	Ozs.	Minis.	C.c.s.	Ozs.	Minis.	C.c.s.	Ozs.	Minis.
1		16.9	6		101.4	11	$\frac{1}{2}$	66
2		33.8	7		118.3	12	$\frac{1}{2}$	83
3		50.7	8	$\frac{1}{2}$	15.2	13	$\frac{1}{2}$	100
4		67.6	9	$\frac{1}{2}$	32	14	$\frac{1}{2}$	117
5		84.5	10	$\frac{1}{2}$	49	15	$\frac{1}{2}$	13

G.O.S. INTO MINIMS AND OUNCES (FLUID).—Continued.

G.O.S.	Ozs.	Minis.	G.O.S.	Ozs.	Minis.	G.O.S.	Ozs.	Minis.
16		30	120	4	107	500	17½	47
17		47	125	4½	72	525	18½	110
18		64	130	4¾	36	550	19½	52
19		81	140	4¾	85	575	20	114
20		98	150	5½	14	600	21	56
25		82	160	5½	63	625	22	0
30	1	27	170	5½	112	650	22½	61
35	1	111	175	6	76	675	23½	4
40	1½	76	180	6½	41	700	24½	66
45	1½	40	190	6¾	90	725	25½	8
50	1½	5	200	7	20	750	26½	70
55	1½	89	225	7½	81	775	27½	13
60	2	54	250	8½	24	800	28	75
65	2½	18	275	9½	86	825	29	18
70	2½	103	300	10½	28	850	29½	80
75	2½	67	325	11½	90	875	30½	22
80	2½	32	350	12½	33	900	31½	66
85	2½	116	375	13	95	925	32½	27
90	3	81	400	14	37	950	33½	90
95	3½	45	425	14½	100	975	34½	32
100	3½	10	450	15½	42	1000	35	94
110	3½	58	475	16½	105			

Conversion of British into Metric Measures.

GRAINS INTO GRAMMES.

Gra.	Gms.	Gra.	Gms.	Gra.	Gms.
1	0.065	16	1.037	35	2.268
2	0.13	17	1.102	40	2.598
3	0.194	18	1.166	45	2.916
4	0.259	19	1.232	50	3.240
5	0.324	20	1.296	55	3.564
6	0.389	21	1.361	60	3.888
7	0.454	22	1.426	65	4.212
8	0.518	23	1.490	70	4.536
9	0.583	24	1.555	75	4.860
10	0.648	25	1.620	80	5.184
11	0.713	26	1.685	85	5.508
12	0.776	27	1.750	90	5.832
13	0.842	28	1.814	95	6.156
14	0.907	29	1.880	100	6.480
15	0.972	30	1.944		

AND PHOTOGRAPHER'S READY COMPANION.
OUNCES (AVOIRDUPOIS) TO GRAMMES.

Oms.	Gms.	Ozs.	Gms.	Oms.	Gms.
	7 09	4	113 40	13	368 64
	14 17	5	141 75	14	396 89
	21 26	6	170 10	15	425 24
1	28 35	7	198 45	16	453 69
1½	42 5	8	226 80	17	481 94
2	56 70	9	255 15	18	510 29
2½	70 87	11	311 8	19	538 64
3	85 05	12	340 19	20	566 99

FLUID OUNCES AND DRACHMS TO C.C.S.

Minims.	C.c.s.	Drs.	C.c.s.	Ozs.	C.c.s.	Ozs.	C.c.s.
5	3	1	1 78	1½	42 6	11	312 5
10	6	1	3 55	2	56 8	12	341 0
15	9	2	7 10	3	85 2	13	369 3
20	12	3	10 65	4	113 6	14	398 0
25	14	4	14 20	5	142 0	15	426 0
		5	17 75	6	170 5	16	454 5
		6	21 30	7	198 9	17	483 0
		7	24 86	8	227 3	18	511 5
		8	28 41	9	255 7	19	540 0
				10	284 0	20	568 0

CONVERSION RULES

Grammes per litre into grains per ounce.—Multiply the grammes by 0.44.

C.c.s. per litre into minims per ounce.—Divide the c.c.s. by 3 (more exactly, multiply by 0.48).

Grains per ounce into grammes per litre.—Multiply the grains by 2.3. Thus 50 gra. per oz. = 115 gms. per litre.

Minims per ounce into c.c.s. per litre.—Multiply the minims by 3.

COINS AS WEIGHTS

Silver coinage, it is useful to note, is minted exactly by weight in proportion to its value, viz., $436\frac{1}{11}$ grains for every 5s. Thus the threepenny bit is 21.8 grs., a sixpence 43.6, shilling, 87.2, florin, 175.4, half crown, 218 grs.

Thus the sixpence and threepenny piece are almost exactly one tenth and one twentieth of the avoirdupois ounce.

Bronze coinage—Three pennies, or five halfpennies, or ten farthings = 1 oz. (avoirdupois).

the penny 145.8 grs., 1 halfpenny, 87.5 and 1 farthing, 43.75 grs.

One sovereign weighs 123.27 grs., the half sovereign, 61.63 grs.

$\frac{1}{2}$ oz. (avoir) one halfpenny and one threepenny piece

$\frac{1}{4}$ " two halfpennies and a farthing

1 " three pennies (or five halfpennies)

2 " six pennies (or ten halfpennies)

4 " twelve pennies (or twenty halfpennies)

FRENCH COINS AS METRIC WEIGHTS

Lord Crawford's table

	<i>Silver Coins</i>			<i>Bronze Coins</i>	
25 grms	5 francs	10 grms	10 centimes		
10 "	2 "	5 "	5 "		
5 "	1 "	2 "	2 "		
2½ "	½ " or 50 centimes	1 "	1 "		

PARTS

Formulas given as many are in "parts" may be made up by writing grms. for the solid and ccs. for the fluid 'parts,' and converting them into the British measures by any of the tables in this section. Thus Adurol, 10 parts, sodium sulphite, 100 parts, water 1000 parts becomes adurol, 154 grs., sodium sulphite, 3 ozs. 230 grs., water 35 ozs.

INCHES INTO MILLIMETRES.

MILLIMETRES INTO INCHES.

Inches.	Milli- metres.	Inches.	Milli- metres.	Milli- metres	Inches	Milli- metres.	Inches
1	25.4	$\frac{1}{8}$	9.5	0.1	0.0039	13	0.51
$\frac{1}{16}$	23.8	$\frac{1}{16}$	8.7	0.5	0.015	14	0.56
$\frac{1}{8}$	23.0	$\frac{1}{8}$	7.9	1	0.04	15	0.59
$\frac{3}{16}$	22.2	$\frac{3}{16}$	7.1	2	0.08	16	0.63
		$\frac{1}{4}$		3	0.12	17	0.67
$\frac{1}{4}$	20.6	$\frac{1}{4}$	6.4	4	0.16	18	0.71
$\frac{5}{16}$	19.1	$\frac{5}{16}$	5.6	5	0.20	19	0.75
$\frac{3}{8}$	17.5	$\frac{3}{8}$	4.8	6	0.24	20	0.79
		$\frac{1}{2}$		7	0.28	21	0.83
$\frac{1}{2}$	15.9	$\frac{1}{2}$	3.2	8	0.31	22	0.87
$\frac{5}{8}$	14.3	$\frac{5}{8}$	2.4	9	0.53	23	0.90
$\frac{3}{4}$	12.7	$\frac{3}{4}$	1.6	10	0.39	24	0.94
$\frac{7}{8}$	11.1	$\frac{7}{8}$	0.8	11	0.43	25	0.98
				12	0.47	25.4	1.0

ENGLISH SIZES OF PLATES

Inches	Cm	Inches	Cm
$3\frac{1}{2} \times 2\frac{1}{2}$	8.9 x 6.4	7 x 5	17.8 x 12.7
$3\frac{1}{2} \times 3\frac{1}{4}$	8.25 x 8.25	$8\frac{1}{2} \times 6\frac{1}{2}$	21.5 x 16.5
$4\frac{1}{2} \times 3\frac{1}{4}$	10.8 x 8.25	10 x 8	25.4 x 20.3
5 x 4 ¹	12.7 x 10.1	12 x 10	30.4 x 25.4
$6\frac{1}{2} \times 4\frac{3}{4}$	16.5 x 12.0	15 x 12	38.1 x 30.4

¹ Lantern plate ² Quarter plate ³ Smallest common size in America ⁴ Half plate ⁵ Usual medium size in America ⁶ Whole plate

CONTINENTAL SIZES OF PLATES IN COMMON USE

Cm	Inches	Cm	Inches
4.5 x 6.0*	$1\frac{3}{4} \times 2\frac{3}{8}$	13 x 21	5.12 x 8.25
9 x 12†	3.54 x 4.72	18 x 24	7.08 x 9.44
12 x 16	4.72 x 6.30	24 x 30	9.44 x 11.81
13 x 18‡	5.12 x 7.08	30 x 40	11.81 x 15.75

* Standard size of vest pocket plate camera

† The standard small size equivalent to the British quarter plate

‡ The standard medium size (British half plate)

FOREIGN LANTERN SLIDES

The standard French size for lantern slides is 10 by 8 cm., though many makers prepare slides $3\frac{1}{2}$ by $3\frac{1}{2}$. The American size is 4 by $3\frac{1}{2}$, though some makers use the English quarter plate ($4\frac{1}{2}$ by $3\frac{1}{2}$).

CHEMICAL TABLES.

TABLE OF SYMBOLS AND EQUIVALENT WEIGHTS OF THE MORE IMPORTANT COMPOUNDS USED IN PHOTOGRAPHY.

The atomic weights of the elements employed in working out the equivalent weights given below are the round numbers contained in the first column of the Table of Atomic Weights on page 673.

NAME.	SYMBOL.	EQUIV. WEIGHT
Acetone	C_3H_6O	58
sulphite	$C_3H_6OH SO_3 Na$	162
Acid, acetic	$C_2H_4O_2$	60
benzole	C_6H_6COOH	122
boric	H_3BO_3	62
carbolic	C_6H_5OH	94
chlorochromic	$(Cl Cr O_2 OH)$	136
chromic (anhydride)	$Cr O_3$	100
citric	$C_6H_8O_7 H_2O$	210
dithionio	$H_2S_2O_6$	162
formic	H_2CO_2	46
gallic	$C_6H_3(OH)_3COOH, H_2O$..	188
hydrobromic	$H Br$	81
hydrochloric	$H Cl$	36.5
hydrofluoric	$H F$	34
lactic	$CH_3CH(OH)COOH$	90
nitric	HNO_3	63
oxalic	$H_2C_2O_4$	126
pentathionic	$H_2S_5O_6$	258
perchromic	$H Cr O_4$	117
phosphoric	H_3PO_4	98
picric	$C_6H_3(NO_2)_3OH$	139
pyrogallio	$C_6H_3(OH)_3$	126
salicylic	$C_6H_4(OH)COOH$	138
sulphuric	H_2SO_4	98
sulphurous	H_2SO_3	82
tannic	$C_{14}H_{10}O_9$	322
tartaric	$C_4H_6(OH)_2(COOH)_2$	150
tetrathionic	$H_2S_4O_6$	208
trithionic	$H_2S_3O_6$	194
Adurol*	$C_6H_5(OH)_2Cl$ (or Br)	—
Alcohol (methyl)	CH_3OH	32
(ethyl)	C_2H_5OH	46

* Adurol is mono-chlor (or mono-brom) hydroquinone.

TABLES OF SYMBOLS, &c.—CONTINUED.

NAME.	SYMBOL.	EQUIV. WEIGHT.
Alum, ammonia	$Al_2(NH_4)_2(SO_4)_3 \cdot 24H_2O$..	806
" chrome	$Cr_2K_2(SO_4)_4 \cdot 24H_2O$	998
" iron ammonia	$Fe_2(NH_4)_2(SO_4)_4 \cdot 24H_2O$..	984
" potash	$Al_2K_2(SO_4)_4 \cdot 24H_2O$	948
Aluminium chloride	$Al_2Cl_3 \cdot 12H_2O$	287
" sulphate	$Al_2(SO_4)_3 \cdot 16H_2O$	634
" sulphocyanide	$Al_2(UNS)_6$	402
Amidol	$C_6H_5OH(NH_2) \cdot 2HCl$	197
Ammonia	NH_3	17
Ammonium bichromate	$(NH_4)_2Cr_2O_7$	292
" bromide	NH_4Br	98
" carbonate	$NH_4HCO_3 + NH_4COOH \cdot NH_3$..	—
" chloride	NH_4Cl	53.5
" chromate	$(NH_4)_2CrO_4$	152
" citrate	$(NH_4)_3C_6H_5O_7$	226
" iodide	NH_4I	145
" molybdate	$(NH_4)_6Mo_7O_{24} \cdot 4H_2O$	1236
" nitrate	NH_4NO_3	80
" oxalate	$(NH_4)_2C_2O_4 \cdot H_2O$..	142
" persulphate	$(NH_4)_2S_2O_8$	228
" phosphate	$(NH_4)_3HPO_4$	132
" sulphate	$(NH_4)_2SO_4$	132
" sulphide	NH_4HS	51
" sulphocyanide	NH_4CNS	76
" vanadate	NH_4VO_3	117
Amyl, acetate	$C_7H_{14}O_2$	130
" alcohol	$(CH_3)_2CHCH_2CH_2OH$	88
Aniline	$C_6H_5NH_2$	93
Antimony, sulphide	Sb_2S_3	336
Aurantia	$(C_6H_5(NO_2))_3N \cdot NH_4$	466
Aurine	$C(C_6H_5OH)_3 \cdot C_6H_5O$	290
Barium, bromide	$BaBr_2 \cdot 2H_2O$	333
" chloride	$BaCl_2 \cdot 2H_2O$	244
" iodide	BaI_2	391
" nitrate	$Ba(NO_3)_2$	261
" peroxide	BaO_2	201
" sulphate	$BaSO_4$	233
Benzole (benzene)	C_6H_6	78
Borax (see Sodium borate)		
Bromine	Br	80
Cadmium, bromide	$CdBr_2 \cdot 4H_2O$	344
" chloride	$CdCl_2$	183
" iodide	CdI_2	366
Calcium, carbide	CaC_2	64
" carbonate	$CaCO_3$	100
" chloride (cryst.)	$CaCl_2 \cdot 6H_2O$	219

TABLE OF SYMBOLS, &c.—CONTINUED.

NAME.	SYMBOL.	EQUIV. WEIGHT.
Calcium, chloride (fused)	Ca Cl_2	111
„ hypochlorite	Ca (O Cl)_2	153
„ sulphate	$\text{Ca SO}_4 \cdot 2\text{H}_2\text{O}$	172
„ hydroxide (slaked lime) ..	Ca (OH)_2	74
Carbon, bisulphide	C S_2	76
Celloidin	$\text{C}_{12} \text{H}_{16} \text{O}_6 (\text{NO}_2)_4$	504
Ceric, sulphate	$\text{Ce (SO}_4)_2 \cdot 4\text{H}_2\text{O}$	404
Chloral hydrate	$\text{C Cl}_3 \text{ CH (OH)}_2$	165.5
Chloroform	CH Cl_3	119.5
Chrysoidine	$\text{C}_6 \text{H}_5 \text{N}_2 \cdot \text{C}_6 \text{H}_5 (\text{NH}_2)_2$..	211.7
Cobalt, chloride	$\text{Co Cl}_2 \cdot 6\text{H}_2\text{O}$	238
Copper, bromide	Cu Br_2	223.5
„ chloride	$\text{Cu Cl}_2 \cdot 2\text{H}_2\text{O}$	170.5
„ nitrate	$\text{Cu (NO}_3)_2 \cdot 6\text{H}_2\text{O}$	357.5
„ sulphate	$\text{Cu SO}_4 \cdot 5\text{H}_2\text{O}$	249.5
Cyanine	$\text{C}_{20} \text{H}_{25} \text{N}_2 \text{I}$	544
Dextrine	$(\text{C}_6 \text{H}_{10} \text{O}_5)_x$	—
Diamidophenol	$\text{C}_6 \text{H}_5 \text{ OH (NH}_2)_2$	124
Edinol*	—	—
Elkonogen†	$\text{C}_{10} \text{H}_6 (\text{OH}) \text{NH}_2 \text{ SO}_3 \text{ O Na}$..	263
Eosine	Na or K Salt of	—
Erythrosine	$\text{C}_6 \text{H}_4 (\text{CO})_2 \text{O (C}_6 \text{H OH X)}_2$..	—
„	$\text{C}_6 \text{H}_4 (\text{CO})_2 \text{O (C}_6 \text{H OH X}_2)_2$..	—
„	$\text{C}_6 \text{H}_{10} \text{O}$	74
Ether	40 % sol. of CH_3O	—
Ferrous and ferric salts (See Iron)	—	—
Formaline	$\text{C}_6 \text{H}_5 (\text{OH})_3$	92
Glycerine	$\text{C}_6 \text{H}_4 \text{ OH NHOH}_2 \text{ COOH}$..	167
Glycolin§	$\text{H Au Cl}_4 \cdot 4\text{H}_2\text{O}$	412
Gold, chloride yellow	H Au Cl_4	340
„ „ brown	$\text{K Au Cl}_4 \cdot 2\text{H}_2\text{O}$	414
„ „ potassium	$\text{Na Au Cl}_4 \cdot 2\text{H}_2\text{O}$	398
„ „ sodium	H_2O_2	34
Hydrogen, peroxide	$\text{C}_6 \text{H}_4 (\text{OH})_2$	110
Hydroquinone	I	127
Iodine	Ir Cl_3	299.5
Iridious chloride	Ir Cl_4	335
„ tetrachloride	$\text{K}_2 \text{ Ir Cl}_6$	484
„ potassium „	$\text{Na}_2 \text{ Cl}_6$	452
„ sodium „	—	—
IRON.	—	—
Ferric chloride (dry)	$\text{Fe}_2 \text{ Cl}_6$	325

* Edinol is the hydrochloride of γ -amido-oxy-benzyl-alcohol.

† Elkonogen is the sodium salt of amido- β -naphthol- β -monosulphuric acid.

‡ The X in these formulæ may be bromine, iodine, or chlorine, which elements in their proportions constitute the various commercial dyes.

§ Glycolin is γ -oxyphenyl-glycin or γ -oxyphenyl-amido-acetic acid.

TABLES OF SYMBOLS, &c.—CONTINUED.

NAME.	SYMBOL	EQUIV. WEIGHT.
Ferric chloride (lump)	$\text{Fe}_2 \text{Cl}_6 \cdot 12\text{H}_2\text{O}$	541
„ ammonia citrate, brown..	$4 \text{ Fe } \text{C}_6 \text{H}_5 \text{O}_7 \cdot 3(\text{NH}_4)_2 \text{C}_6\text{H}_5\text{O}_7 \cdot 3\text{Fe}(\text{OH})_3$	2030
„ „ „ green ..	$5 \text{ Fe } \text{C}_6\text{H}_5\text{O}_7 \cdot 2(\text{NH}_4)_2 \text{C}_6\text{H}_5\text{O}_7 \cdot \text{NH}_4\text{C}_6\text{H}_5\text{O}_7 \cdot 2\text{H}_2\text{O}$	1956
„ oxalate	$\text{Fe}_2(\text{C}_2\text{O}_4)_3$	376
„ ammonium oxalate	$(\text{NH}_4)_3 \text{Fe}(\text{C}_2\text{O}_4)_3 \cdot 3\text{H}_2\text{O}$	428
„ potassium „	$\text{K}_3 \text{Fe}(\text{C}_2\text{O}_4)_3 \cdot 3\text{H}_2\text{O}$	491
„ sodium „	$\text{Na}_3 \text{Fe}(\text{C}_2\text{O}_4)_3 \cdot 11\text{H}_2\text{O}$	976
Ferrous, chloride (dry)	FeCl_2	127
„ „ (cryst.)	$\text{FeCl}_2 \cdot 4\text{H}_2\text{O}$	199
„ oxalate	$\text{FeC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$	180
„ potassium oxalate	$\text{K}_2 \text{Fe}(\text{C}_2\text{O}_4)_2 \cdot \text{H}_2\text{O}$	328
„ sulphate	$\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$	278
„ ammonia sulphate	$\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	392
Lead, acetate	$\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 3\text{H}_2\text{O}$	379
„ nitrate	$\text{Pb}(\text{NO}_3)_2$	331
Lithia, caustic	LiOH	24
Lithium, bromide	LiBr	87
„ carbonate	Li_2CO_3	74
Lithium, chloride	LiCl (cryst. has $2\text{H}_2\text{O}$)	42.5
„ iodide	LiI	134
Magnesium, chloride	MgCl_2	95
„ sulphate	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$	246
Manganese, peroxide	MnO_2	87
„ sulphate	$\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$	225
Mercury	Hg	200
„ bichloride	HgCl_2	271
„ iodide	HgI_2	454
„ potass. iodide (soluble) ..	$\text{HgI}_2 \cdot 2\text{KI}$	786
Metol*	$(\text{C}_6\text{H}_4(\text{OH})\text{NHCH}_3)_2 \cdot \text{H}_2\text{SO}_4$	344
Ortol†	$(\text{C}_6\text{H}_4(\text{OH})\text{NHCH}_3)_2 + \text{C}_6\text{H}_4(\text{OH})_2$	234
Palladium chloride	PdCl_2	177
„ potassium chloride	$\text{K}_2 \text{PdCl}_4$	326
Para-amidophenol	$\text{C}_6\text{H}_4 \text{NH}_2 \text{OH}$	109
Phenol (see Acid carbollic)		
Platinum per (or bi)chloride	$\text{H}_2 \text{PtCl}_6 \cdot 6\text{H}_2\text{O}$	516.4
Potassium, ammonium chromate ..	$\text{K NH}_4 \text{CrO}_4$	173
„ bicarbonate	K HCO_3	100
„ bichromate	$\text{K}_2 \text{Cr}_2\text{O}_7$	294
„ boro-tartrate	$\text{C}_2\text{H}_3(\text{OH})_2(\text{CO}_2)_2 \text{BOK}$	214
„ bromide	KBr	119
„ carbonate (dry)	K_2CO_3	138

* Metol is the sulphate of mono methyl-para-amido phenol.

† Ortol is a mixture of one molecule each of methyl-ortho-amido phenol and hydroquinone.

TABLES OF SYMBOLS, &c. -CONTINUED.

NAME.		SYMBOL.	EQUIV. WEIGHT.
Potassium	chlorate	$K Cl O_3$	122.5
"	chloride	$K Cl$	74.5
"	chloro-platinite	$K_2 Pt Cl_4$	413.4
"	chromate	$K_2 Cr O_4$	194
"	citrate	$K_2 C_6 H_5 O_7 \cdot H_2 O$	342
"	cyanide	$K C N$	65
"	ferricyanide	$K_3 Fe (CN)_6$	329
"	ferrocyanide	$K_4 Fe (CN)_6 \cdot 3 H_2 O$	422
"	hydrate	$K HO$	56
"	iodide	$K I$	166
"	metabisulphite	$K_2 S_2 O_5$	222
"	nitrate	$K NO_3$	101
"	nitrite	$K NO_2$	85
"	oxalate	$K_2 C_2 O_4 \cdot H_2 O$	184
"	percarbonate	$K_2 C_2 O_8$	198
"	perchlorate	$K Cl O_4$	138.5
"	permanganate	$K_2 Mn_2 O_8$	316
"	persulphate	$K_2 S_8 O_8$	270
"	sulphate	$K_2 SO_4$	174
"	sulphocyanide	$K C N S$	97
Pyrocatechin	.....	$C_6 H_4 (OH)_2$	110
Rochelle salt	.....	$K Na C_4 H_4 O_6 \cdot 4 H_2 O$	282
Schlippe's salt (sodium sulphant)	.....	$Na_3 Sb S_4 \cdot 9 H_2 O$	479
..... moulate)	.....	
Silver, acetate	.....	$Ag C_2 H_3 O_2$	167
"	ammonium nitrate	$Ag NO_3 + 2 NH_3$	204
"	bromide	$Ag Br$	188
"	carbonate	$Ag_2 CO_3$	276
"	chloride	$Ag Cl$	143.5
"	citrate	$Ag C_6 H_5 O_7$	513
"	fluoride	$Ag F \cdot 4 H_2 O$	199
"	iodide	$Ag I$	236
"	nitrate	$Ag NO_3$	170
"	nitrite	$Ag NO_2$	154
"	oxalate	$Ag_2 C_2 O_4$	304
"	oxide	$Ag_2 O$	224
"	phosphate	$Ag_3 PO_4$	419
"	sulphate	$Ag_2 SO_4$	312
"	sulphide	$Ag_2 S$	248
"	tartrate	$Ag_2 C_4 H_4 O_6$	365.4
Sodium, acetate	.....	$Na C_2 H_3 O_2 \cdot 3 H_2 O$	136
"	" (fused)	$Na C_2 H_3 O_2$	102
"	bicarbonate	$Na H CO_3$	84
"	bichromate	$Na_2 Cr_2 O_7 \cdot 2 H_2 O$	298
"	bisulphite	$Na H SO_3$	104

TABLES OF SYMBOLS, &c.—CONTINUED.

NAME.	SYMBOL.	EQUIV. WEIGHT.
Sodium, borate	$\text{Na}_2 \text{B}_4 \text{O}_7 \cdot 10\text{H}_2\text{O}$	382
" bromide	$\text{Na Br} \cdot 2\text{H}_2\text{O}$	139
" carbonate (dry)	$\text{Na}_2 \text{CO}_3$	106
" carbonate (cryst.)	$\text{Na}_2 \text{CO}_3 \cdot 10\text{H}_2\text{O}$	286
" chloride	Na Cl	58.5
" chloro-platinate	$\text{Na}_2 \text{Pt Cl}_6 \cdot 6\text{H}_2\text{O}$	560.4
" citrate	$\text{Na}_3 \text{C}_6 \text{H}_5 \text{O}_7 \cdot 5\frac{1}{2}\text{H}_2\text{O}$	357
" fluoride	Na F	42
" hydrate (caustic)	Na OH	40
" hydrosulphite*	Na H SO_2	88
" hyposulphite†	$\text{Na}_2 \text{S}_2 \text{O}_4 \cdot 5\text{H}_2\text{O}$	248
" iodide	Na I	150
" nitrate	Na NO_3	85
" nitro-prusside	$\text{Na}_4 \text{Fe}_2 (\text{CN})_{10} (\text{NO})_2 \cdot 4\text{H}_2\text{O}$	600
" oxalate	$\text{Na}_2 \text{C}_2 \text{O}_4$	134
" phosphate	$\text{Na}_2 \text{HPO}_4 \cdot 12\text{H}_2\text{O}$	358
" tribasic phosphate	$\text{Na}_3 \text{PO}_4 \cdot 12\text{H}_2\text{O}$	380
" sulphate (cryst.)	$\text{Na}_2 \text{SO}_4 \cdot 10\text{H}_2\text{O}$	322
" sulphide	$\text{Na}_2 \text{S} \cdot 9\text{H}_2\text{O}$	240
" sulphite (dry)	$\text{Na}_2 \text{SO}_3$	126
" " (cryst.)	$\text{Na}_2 \text{SO}_3 \cdot 7\text{H}_2\text{O}$	252
" tungstate	$\text{Na}_{10} \text{W}_{12} \text{O}_{41} \cdot 28\text{H}_2\text{O}$	3598
Strontium, bromide	Sr Br_2	247.5
" chloride (dry)	Sr Cl_2	159.5
" " (cryst.)	$\text{Sr Cl}_2 \cdot 2\text{H}_2\text{O}$	191.5
" iodide	Sr I_2	341.5
" nitrate	$\text{Sr} (\text{NO}_3)_2$	211.5
Thiocarbamide	$\text{CS} (\text{NH}_2)_2$	76
Thiosinamine	$\text{CS} (\text{NH}_2) \text{NH C}_6 \text{H}_5$	116
Thymol	$\text{CH}_3 \text{C}_6 \text{H}_4 \text{OH C}_6 \text{H}_7$	150
Tin (Stannous) chloride	$\text{Sn Cl}_2 \cdot 2\text{H}_2\text{O}$	225
Uranium, acetate	$\text{UO}_2 (\text{C}_2 \text{H}_3 \text{O}_2)_2 \cdot 2\text{H}_2\text{O}$	426
" chloride	$\text{UO}_2 \text{Cl}_2$	343
" nitrate	$\text{UO}_2 (\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	504
Zinc, sulphate	$\text{Zn SO}_4 \cdot 7\text{H}_2\text{O}$	287

* Called "hyposulphite" by chemists.

† Called "thiosulphate" by chemists.

TABLE OF THE SOLUBILITIES OF THE PRINCIPAL SUBSTANCES USED IN PHOTOGRAPHY.

sol.=soluble, v.s.=very soluble; s.s.=slightly soluble; dec.=decomposed;
insol.=insoluble

Name.	One part is soluble in — parts of water.		100 parts of water dissolve at ordinary temperature	Solubility in Alcohol, &c.
	Cold.	Boiling		
Acetone .....	..	..	..
„ sulphite	v.s.	..	..	s.s.
Acid, acetic	..	..	..
„ benzoic	380	45	0 27	1 in 2·75 90%
„ boric ..	29	2 9	3½	1 in 28 90%
„ carbolic	15	..	6 6	v.s.
„ chromic (anhydride)	0 6	v s	160	sol with decomp'.
„ citric ..	½	½	130	
„ formic ..	..	..	..

Acetone.—(Sp. gr 0·814), boils at 133°F, miscible in all proportions with water, alcohol and ether. 272 gms. dissolve in 100 gms. 20% cane sugar solution at 60°F. A solvent of resin, fats, camphor, pyroxylin and celluloid.

Acetic Acid.—The "glacial" acid, which is that implied in formulae unless a weaker acid is directed, solidifies about 50°. Its sp. gr. is 1·055, it boils at 245°F. It is a solvent of gelatine, celluloid, pyroxyline, fats, oils, etc., blisters the skin, strongly absorbs water from the air, and is miscible with water, alcohol, ether, chloroform and glycerine in all proportions.

Formic Acid.—A colourless liquid of 1·22 sp. gr. (=100% acid), miscible with water and alcohol. Weaker solutions are —1·20 (90%), 1·18 (80%), 1·15 (65%); 1·12 (50%) and 1·06 (25%).

Hydroiodic Acid.—A solution of the gas HI, and obtainable as strong as sp. gr. 2·0 (=36% HI). Solution of sp. gr. 1·7 contains about 52%; sp. gr. 1·5, about 43%.

Hydrobromic Acid.—A solution of the gas, HBr, in water. The strongest solution has sp. gr. of 1·78 (=32%); sol. of 1·495 sp. gr. contains 48% HBr, 1·34, 40%, 1·206, 25%.

Hydrochloric Acid.—A solution of the gas, HCl, in water. The commercial strongest acid has sp. gr. 1·16, and contains about 30% HCl. Impure acid is sold as "spirits of salt."

Hydrocyanic Acid.—(=Prussic Acid).—The strength of the official acid of the British Pharmacopoeia is 2%. A 10% acid is obtainable in the chemical trade. Both are the most deadly and dangerous poisons.

Hydrofluoric Acid is a strongly fuming solution of the gas HF.; it is sold at strengths 40% and 55% HF.

Lactic Acid is sold as a colourless syrupy liquid, miscible with water or alcohol. Sp. gr. 1·21. A weaker acid is also sold commercially containing 50% acid.

TABLE OF THE SOLUBILITIES, &c.—CONTINUED.

Name.	One part is soluble in — parts of water.		100 parts of water dissolve at ordinary temperature	Solubility in Alcohol, &c.
	Cold.	Boiling		
Acid, gallic	100	0.3	1	1 in 5 90% alcohol 1 in 40 ether
„ oxalic	9.5	0.3	10½	
„ picric	100	..	1	1 in 10 90%, also in ether
„ pyrogallic	2½	v s	44	sol. also in ether, not in chloroform
„ salicylic	500	12½	½	1 in 35, 1 in 2 in ether
„ tannic	0.5	.	20	1 in 0.6, nearly insol. in ether
„ tartaric	½	½	132	
Alum, ammonia	8.3	0.24	12	insoluble
„ chrome	6	dec	16	
„ iron ammonia	3	dec	33	insoluble
„ potash	10	v s	9.6	insoluble
Aluminium, chloride	½	v s	400	soluble
„ sulphate	3	1.1	35	
Amidol	4	v s	24	less sol. in alc. & eth.
Ammonium, bichromate.. . . .	5	½	20	1 in 31 absolute alc
„ bromide	1.4	v s	72	

Nitric Acid—Strongly corrosive liquid of 1.42 sp gr (=71% HNO_3), soluble in water, oxidises alcohol and other organic solvents.

Phosphoric Acid—Solid as syrupy liquid, that of 1.75 sp gr (=about 90% acid) being intended when 'phosphoric acid' is prescribed in formulae.

Sulphuric Acid—The commercial strong acid is a thick corrosive liquid of 1.84 sp. gr. (=98% H_2SO_4). It absorbs water rapidly from the air, and, mixed with water, great heat is developed. The acid should always be added to water—not *vice versa*.

Sulphurous Acid—Solution in water of the gas SO_2 , saturated solution of 1.046 is equivalent to 9.5% H_2SO_3 , but soon loses strength.

Albumen—On heating the cold solution to 160 F. the albumen separates in insoluble form. Alcohol similarly coagulates albumen.

Methyl Alcohol (sp gr. 0.814)—The chief constituent of crude "wood spirit," or wood naphtha, in which is usually 10% of acetone.

Ethyl Alcohol forms "absolute alcohol" (sp gr. 0.830 to 0.834), which contains from 3 to 5% water. Alcohol containing 16% water is "rectified spirit." "Methylated" spirit consists of rectified spirit plus 10% crude wood spirit and 1% mineral naphtha, the latter precipitating as a milkiness on addition of water. These various forms of alcohol mix with water, which can be abstracted with dry potassium carbonate.

Aluminium Chloride—100 gms. saturated solution (sp gr. 1.35) contains 41.1 gms. aluminium chloride.

TABLE OF THE SOLUBILITIES, &c.—CONTINUED.

Name.	One part is soluble in—parts of water.		100 parts of water dissolve at ordinary temperature.	Solubility in Alcohol, &c.
	Cold.	Boiling.		
Ammonium carbonate ..	4	dec.	25	
„ chloride	3	1·4	35	
„ citrate	$\frac{1}{2}$	v.s.	200	
„ iodide	0·6	v.s.	165	1 in 4 alc., s.s. in ether
„ molybdate ..	$2\frac{1}{2}$	dec.	40	
„ nitrate	$\frac{1}{2}$	v.s.	200	
„ oxalate	23	2·4	4·3	sol.
„ persulphate ..	$1\frac{1}{2}$	dec.	65	
„ sulphocyanide	0·6	v.s.	160	v.s.
„ vanadate	s.s.	v.s.	..	
Antimony sulphide	insol	..	..
Aurantia	s.s.	..	..	v.s.; s.s. in ether
Aurine	s.s.	..	..	sol.; also in ether
Barium bromide	0·75	0·5	133	v.s. in benzole
„ chloride	2·4	1·3	42	insol.
„ iodide	$\frac{1}{2}$	v.s.	200	1 in 20 alcohol
„ nitrate	12	3·1	8	insol.
Bromine	31	..	3·2	
Cadmium bromide	0·94	v.s.	106	1 in 3 alc.; 1 in 250 eth.
„ ammonium bromide	0·7	v.s.	137	
„ chloride	0·71	0·67	140	1 in 8 alcohol
„ iodide	1·08	0·75	93	1 in 1 alc.; 1 in 3·6 eth.
Calcium chloride (cryst.)	$\frac{1}{2}$	v.s.	400	
„ „ (fused) ..	1·4	0·65	70	
„ sulphate	380	450	0·3	
„ hydroxide	700	1,300	0·137	
Coric sulphate	12	200	8·3	
Chloral hydrate	$\frac{1}{2}$	..	400	1 in 1/5 90%, 1 in 50 carbon bisulphide.
Copper bromide	v.s.	v.s.	..	
„ chloride	0·83	v.s.	121	v.s.; also in ether.
„ sulphate	$2\frac{1}{2}$	$\frac{1}{2}$	40	
Cyanine	s.s.	..	..
Diamidophenol	sol.	..	..

Aluminium Sulphocyanide is purchased as a reddish solution of 1·16 sp. gr.

Ammonium Sulphide is sold as a deep yellow solution containing also polysulphides.

Amyl Acetate.—Liquid of sp. gr. 0·876, miscible with alcohol and ether but not with water. A solvent of fats, oils, resin, pyroxyline and celluloid.

Amyl Alcohol, the chief constituent of fusel oil, is not miscible with water.

Acetone (sp. gr. 1·036) is freely miscible with alcohol or ether, but only very slightly with water. It boils at 56° F. and coagulates albumen.

TABLE OF THE SOLUBILITIES, &c.—CONTINUED.

Name.	One part is soluble in — parts of water.		100 parts of water dissolve at ordinary temperature.	Solubility in Alcohol, &c.
	Cold.	Boiling.		
Edinol	sol.	..	..	[cohol or ether.
Eikonogen	25	..	4.2	nearly insol. in al-
Eosine	sol.	..	..	insol. in ether.
Ether	12	..	8	
Erythrosine	s.s.	..	..	s.s.
Gold, chloride	v.s.	v.s.	..	
Hydroquinone	17	..	6	
Iodine	insol.	insol.	..	sol.; also in carbon bisulphide
IRON				
Ferric chloride (lump) ..	v.s.	v.s.	..	
" " (dry)	0.63	v.s.	160	
" ammonium citrate	4	..	25	
" " (brown)*	..	..	..
" " (green)†	..	..	..
" ammonium oxalate	2.1	..	0.48	
" potassium "	15	0.85	6.6	insol
" sodium "	1.69	0.55	60	
Ferrous chloride (dry) ..	2	v.s.	50	
" " (cryst.) ..	0.68	v.s.	147	
" oxalate	4500	3800	..	
" sulphate§	1.43	0.27	70	
" am. sulphate§...	3	..	33	
Lead, acetate	1½	0.5	66	1 in 15 alcohol
Lead, nitrate	2	0.7	50	insol. in ether
Lithia, caustic	s.s.	..	..
Lithium, bromide	0.7	0.4	143	
" carbonate	72	138	1.3	v.s.
" chloride	1½	0.8	80	
" iodide	0.61	0.2	164	v.s.
Magnesium, chloride (dry)	1.7	1½	60	v.s.
" sulphate	1	0.15	100	
Manganese, sulphate	0.8	1	120	

Ether (called also "sulphuric ether") is very volatile and inflammable. Boils at 95° F., sp. gr. 0.722.

Formaline.—A common acausal strong solution (40%) of formic aldehyde, CH_2O .

Gelatine becomes swollen in cold water and dissolves in hot. Dissolved in the cold by oxalic, acetic, hydrochloric, or nitric acid, barium chloride or chloral hydrate. Precipitated from its solution in water by alcohol.

Glycerine.—Miscible with water or alcohol. Sp. gr. 1.265.

Iodine dissolves freely also in carbon bisulphide or potassium iodide solution.

Ferric Oxalate is very soluble, over 20%, it is partially reduced to ferrous oxalate on heating the solution to 212° F.

§ Seven parts of ferrous sulphate correspond to 10 parts ferrous ammonium sulphate. * 21.7 to 22.4% iron. † 14 to 15% iron.

TABLE OF THE SOLUBILITIES, &c.—Continued.

Name.	One part is soluble in — parts of water.		100 parts of water dissolve at ordinary temperature.	Solubility in Alcohol, &c.
	Cold.	Boiling		
Mercury, bichloride.....	16	18	63	insol. in absolute alc.
" iodide	150	..	0 66	1 in 4 90%
Metal	sol.	..	..
Ortol	sol.	..	..	s.s.; also in ether
Para-amido-phenol hydrochloride ..	10	..	10	1 in 22
Phenol (<i>see</i> acid carboic)				
Potassium, bicarbonate .	4	dec	25	
" bichromate ..	10	1	10	
" borotartrate.	$\frac{1}{2}$	v s	135	
" bromide	$\frac{1}{4}$	1	65	
" carbonate(dry)	0 9	0 64	112	1 in 750
" chlorate ...	17	2	6	insol.
" chloride	3	1 75	33	insol.
" chloroplatinic	6	v s	17	
" chromate...	2	1 2	50	insol.
" citrate	0 6	v s	166	insol.
" cyanide....	0 8	v s	122	v s
" ferricyanide..	$2\frac{1}{2}$	1 3	40	1 in 9
" ferrocyanide.	$3\frac{1}{4}$	2	29	
" hydrate ...	$\frac{1}{2}$	v s	200	insol., insol in eth
" iodide	0 7	$\frac{1}{2}$	140	sol
" metabisulphite	sol	dec	..	1 in 16, 90%
" nitrate	$3\frac{1}{2}$	0 4	28	
" nitrite	1	v s	100	
" oxalate	3	v s	33	insol.
" percarbonate	15	dec.	6 5	
" perchlorate .	100	5	1	
" permanganate	16	..	6 25	
" persulphate ..	50	dec	2	
" sulphocyanide	0 46	v s	220	insol. in absolute alc.
" acid sulphate	2	0 8	50	
Pyrocatechin	$\frac{1}{2}$	v s.	80	
Rochelle salt	$\frac{1}{2}$	v s.	66	
Schlippe's salt	3	v s.	33	
Silver, acetate	100	..	1	
" carbonate .	insol	..	..
" chlorate.	5	2	20	
" citrate ¹	insol.	..	..
" cyanide	insol.	..	..
" fluoride ²	v s.	v s.	..	

1. Readily soluble in ammonia and hypo.

2. $\text{AgF} \cdot 4\text{H}_2\text{O}$ is almost as soluble as calcium chloride.

TABLE OF THE SOLUBILITIES, &c.—CONTINUED.

Name.	One part is soluble in — parts of water.		100 parts water dissolve at ordinary temperature.	Solubility in Alcohol, &c.
	Cold	Boiling.		
Silver, nitrate	3 44	0 1	227	1 in 26, 90%
„ nitrite	s.s.	..	..
„ sulphate	87	..	1·15	
„ sulphocyanide ..	insol.	..	..
„ tartrate ..	insol.	..	..
Sodium, acetate ..	2 8	v.s.	36	1 in 50, 90%; insol. in
„ bicarbonate ..	11·3	dec.	8 8	(ether)
„ bichromate ...	1	0 6	100	
„ bisulphite	v.s.	..	..
„ borate	12½	½	8	
„ bromide	1·1	0·9	90	1 in 15
„ carbonate (dry) ..	6	2 2	16 2	
„ „ (cryst.) ..	1 56	v.s.	63 2	
„ chloride	3	2½	35	
„ chloroplatinate ..	sol.	..	..
„ citrate	sol.	..	..	s.s.
„ fluoride	25	..	4	
„ hydrate (caustic) ..	v.s.	v.s.	..	
„ hyposulphite ..	0 6	v.s.	170	insol.
„ iodide	0·6	0 4	166	
„ nitrate	1·1	0 6	85	
„ oxalate ..	35	..	3	
„ phosphate	6 7	1	15	
„ sulphide ..	v.s.	v.s.	..	
„ sulphite (cryst) ..	2 2	1	45	
„ „ (dry) ..	4	..	25	
„ tri-basic phosphate ..	0 5	v.s.	20	
„ tungstate	8 to 12	..	..	insol.
„ (meta) vanadate ..	½	v.s.	200	
Strontium, bromide	1 01	½	100	1 in 30, 90%
„ chloride	1 96	1	51	
„ „ (cryst.) ..	1 33	0 6	75	
„ iodide	0·56	0 25	18	
„ nitrate ..	1 41	1	71	
Thiocarbamide	11	v.s.	9	v.s. also in ether
Thiosinamine ..	17	..	6	1 in 2 90%; also in eth.
Thymol	330	..	0·3	1 in 3·75 90%; also in
Tin (stannous), chloride ..	1½	v.s.	66	{ether,
Uranium, acetate	v.s.	v.s.	..	
„ chloride	v.s.	v.s.	..	
„ nitrate	½	v.s.	200	
Zinc, sulphate	0·62	0·15	161	

**PERCENTAGE OF REAL AMMONIA IN SOLUTIONS OF
DIFFERENT DENSITIES AT 14 C. (57° F.)—CARIUS.**

Specific Gravity.	Per-centage Ammonia	Specific Gravity.	Per-centage Ammonia	Specific Gravity	Per-centage Ammonia	Specific Gravity.	Per-centage Ammonia
0.8844	36.0	0.9052	27.0	0.9314	18.0	0.9651	9.0
0.8864	35.0	0.9078	26.0	0.9347	17.0	0.9670	8.0
0.8885	34.0	0.9106	25.0	0.9380	16.0	0.9709	7.0
0.8907	33.0	0.9133	24.0	0.9414	15.0	0.9749	6.0
0.8929	32.0	0.9162	23.0	0.9449	14.0	0.9790	5.0
0.8953	31.0	0.9191	22.0	0.9484	13.0	0.9831	4.0
0.8976	30.0	0.9221	21.0	0.9520	12.0	0.9873	3.0
0.9001	29.0	0.9251	20.0	0.9556	11.0	0.9915	2.0
0.9026	28.0	0.9283	19.0	0.9593	10.0	0.9959	1.0

INDICATORS

(I.e., Colour Tests for Alkalies and Acids).

	Acid.	Alkaline	In presence of Carbon Dioxide.
Litmus	Bright red	Blue	Reddish purple
Cochineal	Yellow	Reddish violet	Not affected
Methyl orange ..	Red	Yellow brown	Not affected
Phenol-phthalein	Colourless	Intense red	Useless

REACTION OF SUBSTANCES TO VARIOUS INDICATORS

Substance.	Litmus.	Methyl Orange.	Phenol-phthalein.
Alum	acid	neutral	acid
Borax	alkaline	alkaline	neutral
Potass. metabisulphite.....	acid	neutral	acid
Potass. oxalate	neutral	neutral	neutral
Rochelle salt	neutral	neutral	neutral
Silver nitrate	acid	neutral	acid
Sodium bicarbonate	alkaline	alkaline	neutral
Sodium citrate	alkaline	alkaline	neutral
Sodium bisulphite	acid	neutral	acid
Sodium sulphite.....	alkaline	alkaline	neutral
Sodium phosphate	neutral	alkaline	neutral

THERMOMETRIC RULES.

The following rules for the rapid conversion of degrees in one system into another will be found useful

To Convert Centigrade into Fahrenheit.

Degrees Centigrade $\times 9 \div 5 + 32$

Ex $80^{\circ} \text{C} \times 9 \div 5 = 144 \div 5 = 28.8 + 32 = 176^{\circ} \text{F.}$

To Convert Fahrenheit into Centigrade

(Degrees Fahrenheit $- 32$) $\times 5 \div 9$

Ex $-100^{\circ} \text{F} - 32 = -132 \div 9 = -14.67^{\circ} \text{C}$

To Convert Fahrenheit into Réaumur

(Degrees Fahrenheit $- 32$) $\times 5 \div 9$

Ex $-95^{\circ} \text{F} - 32 = -127 \div 9 = -14.11^{\circ} \text{R.}$

To Convert Réaumur into Fahrenheit

Degrees Réaumur $\times 9 \div 4 + 32$

Ex $-16^{\circ} \text{R} \times 9 \div 4 = -36 \div 4 = -9 + 32 = 23^{\circ} \text{F}$

To Convert Centigrade into Réaumur

Degrees Centigrade $\times 4 \div 5$

Ex $60^{\circ} \text{C.} \times 4 \div 5 = 48^{\circ} \text{R}$

To Convert Réaumur into Centigrade

Degrees Réaumur $\times 5 \div 4$

Ex $-80^{\circ} \text{R} \times 5 \div 4 = -100^{\circ} \text{C.}$

COMPARISON OF THERMOMETER SCALES.

EQUIVALENCE OF CENTIGRADE (CELSIUS) AND FAHRENHEIT THERMOMETERS.

Centigrade	Fahrenheit	Centigrade	Fahrenheit	Centigrade	Fahrenheit
0	32 0	35	95 0	70	158 0
1	33 8	36	96 8	71	159 8
2	35 6	37	98 6	72	161 6
3	37 4	38	100 4	73	163 4
4	39 2	39	102 2	74	165 2
5	41 0	40	104 0	75	167 0
6	42 8	41	105 8	76	168 8
7	44 6	42	107 6	77	170 6
8	46 4	43	109 4	78	172 4
9	48 2	44	111 2	79	174 2
10	50 0	45	113 0	80	176 0
11	51 8	46	114 8	81	177 8
12	53 6	47	116 6	82	179 6
13	55 4	48	118 4	83	181 4
14	57 2	49	120 2	84	183 2
15	59 0	50	122 0	85	185 0
16	60 8	51	123 8	86	186 8
17	62 6	52	125 6	87	188 6
18	64 4	53	127 4	88	190 4
19	66 2	54	129 2	89	192 2
20	68 0	55	131 0	90	194 0
21	69 8	56	132 8	91	195 8
22	71 6	57	134 6	92	197 6
23	73 4	58	136 4	93	199 4
24	75 2	59	138 2	94	201 2
25	77 0	60	140 0	95	203 0
26	78 8	61	141 8	96	204 8
27	80 6	62	143 6	97	206 6
28	82 4	63	145 4	98	208 4
29	84 2	64	147 2	99	210 2
30	86 0	65	149 0	100	212 0
31	87 8	66	150 8	105	221 0
32	89 6	67	152 6	110	230 0
33	91 4	68	154 4	115	239 0
34	93 2	69	156 2	120	248 0

A TABLE OF ATOMIC WEIGHTS OF THE CHEMICAL ELEMENTS.

NAME.	Symbol.	Atomic Weight in Round Numbers.	Accurate Atomic Weight.
Aluminium	Al	27	27.1
Antimony	Sb	120	120.2
Argon	A	40	39.9
Arsenic	As	75	75.0
Barium	Ba	137	137.43
Beryllium	Be = Gl	9 1	9.1
Bismuth	Bi	208	208.0
Boron	B	11	11.00
Bromine	Br	80	79.96
Cadmium	Cd	112	112.4
Cesium	Cs	133	132.9
Calcium	Ca	40	40.1
Carbon	C	12	12.0
Cerium	Ce	140	140.26
Chlorine	Cl	35 5	35.461
Chromium	Cr	52	52.11
Cobalt	Co	59	59.00
Copper	Cu	63.5	63.60
Erbium	Er	166	166.0
Fluorine	F	19	19.0
Gadolinium	Gd	156	156.01
Gallium	Ga	70	70.0
Germanium	Ge	72.5.	72.5
Gold	Au	197	197.2
Helium	He	4	4.0
Hydrogen	H	1	1.008
Iodine	I	127	126.97
Iridium	Ir	193	193.0
Iron	Fe	56	55.9
Lanthanum	La	139	138.9
Lead	Pb	207	206.92
Lithium	Li	7	7.03
Magnesium	Mg	24	24.26
Manganese	Mn	55	55.0
Mercury	Hg	200	200.0

A TABLE OF ATOMIC WEIGHTS—CONTINUED.

NAME.	Symbol.	Atomic Weight in Round Numbers.	Accurate Atomic Weight.
Molybdenum	Mo	96	96.0
Neodymium	Nd	144	143.6
Nickel	Ni	59	58.70
Niobium	Nb - Cb	94	94.0
Nitrogen	N	14	14.04
Osmium	Os	191	191.0
Oxygen (Standard) . . .	O	16	16.0
Palladium	Pd	106	106.5
Phosphorus	P	31	31.0
Platinum	Pt	193.4	194.8
Potassium	K	39	39.15
Praseodymium	Pr	141	140.5
Rhodium	Rh	103	103.0
Rubidium	Rb	85	85.5
Ruthenium	Ru	102	101.7
Samarium	Sm	150	150.3
Scandium	Sc	44	44.1
Selenium	Se	79	79.2
Silicon	Si	28	28.4
Silver	Ag	108	107.93
Sodium	Na	23	23.05
Strontium	Sr	87.5	87.6
Sulphur	S	32	32.06
Tantalum	Ta	183	183.0
Tellurium	Te	128	127.6
Terbium	Tb	160	160.0
Thallium	Tl	204	204.1
Thorium	Th	233	232.5
Thulium	Tu	171	171.0
Tin	Sn	118	119.0
Titanium	Ti	48	48.1
Tungsten	W	184	184.0
Uranium	U	240	238.5
Vanadium	V	51	51.4
Ytterbium	Yb	173	173.0
Yttrium	Yt	89	89.0
Zinc	Zn	65	65.4
Zirconium	Zr	91	90.6

TABLE OF POISONS AND ANTIDOTES. Compiled by J. ELSDEN.

Poison	Remarks.	Characteristic Symptoms	Antidote
Vegetable Acids.			
Oxalic Acid, including Potassium Oxalate	1 drachm is the smallest fatal dose known	Hot burning sensation in throat and stomach, vomiting, cramps, and numbness	Chalk, whiting, or magnesia suspended in water. Plaster of mortar can be used in emergency vinegar and water
Ammonia	Vapour of ammonia may cause inflammation of the lungs	Swelling of tongue, mouth, and fauces, often followed by suffocation of the air-passages	White and yolk of raw eggs with milk. In emergency, flour paste may be used
Potash	3 grains, the smallest known fatal dose	Acrid, metallic taste, constriction and burning in throat and stomach, followed by nausea and vomiting	
Mercuric Chloride		Constriction in the throat and at pit of stomach, campy pains and stiffness of abdomen, blue line round the gums	Sulphates of soda or magnesia. Metallic salt bath of zinc
Caustic Alkalies.			
Acetate of Lead	The sub acetate is still more poisonous	Inevitable, gasping respiration, dilated pupils, and spasms in the centre of the jaws	No certain remedy, cold affusion over the head and neck most efficacious
Cyanide of Potassium	a Taken internally 3 hrs fatal. b Applied to wounds and abrasures of the skin	Irritant pain, stomach, and vomit	Sulphate of iron should be applied immediately
Bichromate of Potassium	a Taken internally b Applied to slight abrasions of the skin	Irritant pain, stomach, and vomit	Metformin, or chalk
Mineral Acids.			
Nitric Acid	2 drachms have been fatal	Prickling, tingling, and burning in throat, windpipe, and violent inflammation	(Or iron salt to be given immediately, followed by emetics)
Hydrochloric Acid	1 ounce has caused death		Bicarbonate of soda or carbonate of magnesia or chalk, plaster of the affected part beaten up in water.
Sulphuric Acid	1 drachm has been fatal		
Acetic Acid concentrated	has as powerful an effect as the mineral acids		
Iodine	Variable in its action, 3 grains have been fatal	Acrid taste, tightness about the throat, vomiting	Vomiting should be encouraged and given freely
Mercury	When inhaled	Effects similar to chloroform	Cold affusion and artificial respiration.
Concentrated Mineral Acids.			
Phosphoric Acid	2 grains sufficient to kill a rat	Resembles phosphorus poisoning	No certain remedy, Speedy emetics

ORTHOCHROMATIC DATA.

DISTRIBUTION OF THE COLOURS IN THE SPECTRUM.

(ACCORDING TO LISTING)

Wave length			Wave length.		
BROWN	Limit	819.8	CYAN BLUE.	Limit	491.9
	Middle	768.6		Middle	473.0
IND..	Limit	723.4	INDIGO	Limit	455.6
	Middle	683.2		Middle	439.2
ORANGE	Limit	647.2	VIOLET	Limit	424.0
	Middle	614.9		Middle	409.9
YELLOW	Limit	585.6	LAVENDER.	Limit	396.7
	Middle	559.0		Middle	384.3
GREEN	Limit	531.7		Limit	372.6
	Middle	512.4			

WAVE LENGTHS OF BRIGHT LINES OF ELEMENTS USED IN PLOTTING OUT THE SPECTRUM.

(IN TEN MILLIONTHS OF A MILLIMETRE ANGSTROM UNITS)

TABLE I.

Name of line.	Colour	Salts used.	Wave lengths = λ
Lithium	Red	Lithium chloride or nitrate	6705
Sodium	Orange	Lithium chloride or nitrate	6102
D	Orange	Sodium chloride or bicarbonate	5893
"Little b"	Green	Magnesium ribbon	5183
Strontium	Blue	Strontium chloride or metal	4607
Calcium	Blue	Calcium nitrate or chloride	4287
Potassium	Violet	Potassium chloride	4080

Table I. has been drawn up so as to enable any one with nothing more than an ordinary Bunsen gas burner to construct a chart, by means of which the position of any Fraunhofer line in the spectrum may be determined with sufficient accuracy for all photographic purposes. The salts should be dissolved in distilled water so as to make a saturated solution, a narrow loop of copper or iron wire should be wound with fibrous asbestos, and this repeatedly heated in the flame and allowed to cool.

TABLE II.

C	Red	Hydrogen tube	8863
"Little b"	Green	Magnesium rod	8183
F	Bluish-green	Hydrogen tube	4881
Magnesium	Blue	Magnesium rod	4482
G	Blue	Hydrogen tube	4308
"Little h"	Blue	Hydrogen tube	4102

Table II. will give the data, most easily obtained if a small induction coil is used. A small coil, giving a fat $\frac{1}{4}$ or $\frac{1}{2}$ in. spark, and actuated by three bichromate bottles will suffice to show the lines in this table. The hydrogen tube is, of course, of the well-known Plucker or Salet form. The magnesium may be used in twisted spirals of ribbon, but preferably in rod form, and the rods should be filed to comparatively sharp points. The constricted portion of the vacuum tube and the points of the magnesium rod should be placed parallel to and not at right angles to the slit.

EXPOSURE TABLES.

The following table, based on that of Burton, gives a rough idea of the exposures for various subjects and diaphragms under the following conditions:—

1. Best lighting, midday sunshine in May, June, and July.
2. With the most rapid commercial plates. See below for factors applying to other conditions.

No.	Average Subject with objects in Fore-ground. Street Scenes. Outdoor Figure Studies.	Landscapes with Light Foreground, Lake, River, and Beach Scenes.	Sea, Clouds and Sky.	Subjects with Extra Heavy Foreground, e.g. Dark Trees Doorways, Groups.	Under Trees, Woods, Avenues, Glades, etc.	Portrait in Average Well-lighted Room.
f/4	1/250	1/500	—	1/120	1/20	1/8
f/4.5	1/200	1/400	—	1/100	1/15	1/7
f/5.6	1/130	1/250	—	1/64	1/10	1/4
f/6.3	1/100	1/200	1/1000	1/50	1/8	1/3
f/7	1/80	1/150	1/800	1/40	1/7	2/5
f/8	1/64	1/120	1/600	1/30	1/5	1/2
f/11	1/30	1/60	1/300	1/15	1/2	1
f/16	1/15	1/30	1/150	1/8	1	2
f/22	1/8	1/15	1/80	1/4	2	4
f/32	1/4	1/8	1/40	1/2	4	8
f/45	1/2	1/4	1/20	1	8	16
f/64	1	1/2	1/10	2	16	32

In weather other than bright sunshine the above exposures are multiplied as follows.—

Bright diffused light, the sun behind a cloud ..		$\times 1\frac{1}{2}$	Heavy clouds over the whole sky. Absence of distinct shadows ..		$\times 3$
Light clouds over the whole sky, but light able to cast a visible shadow . . .		$\times 2$	Very dull. Whole sky covered by still heavier clouds		$\times 4$ to 5

At other hours of the day and times of the year the above exposures are multiplied by the numbers in the following table of daylight variation. The figure 1 in the table indicates times for which the above exposures are correct.

VARIATION IN DAYLIGHT FROM MORNING UNTIL
EVENING (FOR LATITUDE OF BRITISH ISLES, NORTH
GERMANY, ETC.)

MORNING.

	12	11	10	9	8	7	6	5	4
January	3½	4	5	12					
February	2	2½	3	4	10				
March	1½	1½	1½	2	3	6			
April	1½	1½	1½	1½	2	3	6		
May	1	1	1	1½	1½	2½	3	6	
June	1	1	1	1	1½	2	2½	5	12
July	1	1	1	1½	1½	2½	3	6	
August	1½	1½	1½	1½	2	3	6		
September	1½	1½	1½	2	3	6			
October..	2	2½	3	4	10				
November	3½	4	5	12					
December	4½	5	6						
	12	1	2	3	4	5	6	7	8

AFTERNOON

A MENTAL RULE FOR TELEPHOTO EXPOSURES.

(CAPTAIN OWEN WHILLER)

Assume that the positive is used at $f/16$. With a meter or by any other means find the exposure required in the ordinary way for stop $f/64$, making due allowance for distance and character of subject. Then multiply the time of exposure thus found by the necessary factor given in the following table for various magnifications -

For 4 magnifications	1	For 10 magnifications	6
5	$\times 1\frac{1}{2}$	11	$\times 7$
6	$\times 2$	12	$\times 8$
7	$\times 3$	13	$\times 10$
8	$\times 4$	14	$\times 12$
9	$\times 5$		

If the tele positive is stopped to $f/11$ or $f/8$ the exposure on which the method is based must be taken as for $f/45$ or $f/32$ as the case may be.

PINHOLE EXPOSURES. (WATKINS POWER NUMBERS*)

W P No.	Diameter		Nearst Needle Size	Good Working Distance
	Line	Inch		Inches
1	0.160	$\frac{1}{16}$	—	—
2	0.080	$\frac{1}{8}$		40
3	0.053	$\frac{1}{16}$	1	20
4	0.040	$\frac{1}{25}$	4	14
5	0.032	$\frac{1}{32}$	5	10
6	0.027	$\frac{1}{36}$	7	8
7	0.023	$\frac{1}{43}$	8	5
8	0.020	$\frac{1}{50}$	10	

Rule for use of W P No. in Column 1 - Multiply W P No. of aperture by its working distance from plate. Use the result as the $f/\text{No.}$ in calculating exposure by meter, tables or other means. Whatever the calculated result is in seconds or fractions of a second, expose that number of minutes or fractions of a minute. Example: W P 6 at 8 inches calculate as $f/48$.

* The principle of this system will be understood from a consideration of an example of focal aperture. A $\frac{1}{16}$ inch aperture at 9 inches - $f/36$. If every second on the actinometer is to be reckoned a minute, the aperture must be one sixtieth the area, that is the diameter must be divided by $\sqrt{60}$ or, near enough, by $\sqrt{64} = 8$. Therefore, an aperture of $\frac{1}{16} \div 8 = \frac{1}{128}$ inch diameter = $f/36$ when minutes are given instead of seconds. Therefore, reasoning backwards, a pinhole of $\frac{1}{128}$ inch diameter is called No 4 ($32 \div 8$). Similarly one of half the diameter is No 8 and so on. Mr Watkins, in order to allow for the exposure in excess of the theoretical which is needed in pinhole photography, calculates minutes as seconds at $\frac{1}{16}$ instead of $\frac{1}{128}$, the area of aperture, and therefore his so called W P (Watkins Power number) is obtained by dividing the denominator of the fraction which expresses the diameter of the pinhole by 63 instead of 8. Thus, in the case of a $\frac{1}{128}$ -diameter hole, $32 \div 63 = 62$, or, near enough, W P. No. is 6.

SHUTTER SPEEDS FOR MOVING OBJECTS.

From the "Wellcome Exposure Record and Diary."

The formula and table given below indicate the shutter speeds necessary to secure negatives sufficiently sharp for direct printing. For enlarging it is better to give $\frac{1}{2}$ to $\frac{1}{3}$ these exposures, or to work further from the object. *The figures are no guide to what is the correct exposure for the plate.*

If D = distance of object in feet, F = focal length of lens, S = speed of object in feet per second, and E = exposure for an object moving across the field of view, then

$$E = \frac{D}{100 F \times S}$$

The following table gives in round figures the shutter speeds necessary for various moving objects, using the ordinary quarter plate lens of about 5 in. focus. The column A is for objects moving directly towards the operator, B for objects moving obliquely towards or from the camera, that marked C for objects moving directly across the field of view.

Distance of Object, 25 ft., unless otherwise stated.	A	B	C
Street groups (no rapid motion)	1/5 to 1/10		
Pedestrians (two miles per hour)	1/20	1/40	1/60
Animals grazing ..			
Pedestrians (three miles per hour)	1/30	1/60	1/90
Pedestrians (four miles per hour)	1/40	1/80	1/120
Vehicles (six miles per hour)	1/60	1/120	1/180
Vehicles (eight miles per hour)	1/80	1/160	1/250
Cyclists and trotting horses	1/160	1/300	1/500
Foot races and sports	1/240	1/500	1/700
Divers	—	1/600	1/800
Cycle races, horse galloping	1/300	1/750	1/900
Yachts (10 knots per hour) at 50 ft.	1/60	1/120	1/180
Steamers (20 knots per hour) at 50 ft.	1/120	1/240	1/360
Trains (30 miles per hour) at 50 ft.	1/150	1/300	1/450
Trains (60 miles per hour) at 50 ft.	1/300	1/600	1/900

At 50 ft. the exposure may be double that at 25 ft.

At 100 ft. the exposure may be double that at 50 ft.

OPTICAL CALCULATIONS.

FINDING THE FOCAL LENGTH OF A LENS.

As simple and accurate a method as any is first to focus the lens on an object at an infinite distance (see table on page 686), and to mark the position of any convenient part of the moving lens front on the fixed camera baseboard, then place any object such as a foot rule before the camera, and focus—by moving only (1) camera as a whole and (2) camera front on baseboard, not back of camera—until image on screen is same size as original. The distance through which the camera front has to be moved to secure this is the focal length of the lens, and is indicated by the separation of the mark on the fixed baseboard from that on the lens front in its final (same-size) position.

FOCAL DISTANCES WHEN COPYING ON A REDUCED SCALE.

When reducing an original x times (linear), distance from original to lens is found by *multiplying* focal length of lens by x and adding one focal length.

Example—Reducing 12 in. to 4 in. (reduction of 3 linear) with 6 in. lens, distance from original to lens is $6 \times 3 + 6 = 24$ in.

Distance from lens to plate is found by *dividing* focal length by x and adding one focal length.

Thus (conditions as above) $6 \div 3 + 6 = 8$ in.

FOCAL DISTANCES WHEN ENLARGING WITH CAMERA OR LANTERN.

When enlarging a negative x times (linear), distance from negative to lens is found by *dividing* focal length of lens by x and adding one focal length.

Example.—4 inches in negative to 16 inches in enlargement, that is x equals 4. With lens of 8 inch focus, distance from lens to negative is $8 \div 4 + 8 = 10$ in.

Distance from lens to sensitive paper or plate is found by *multiplying* focal length of lens by x and adding one focal length.

Thus (conditions as above) $8 \times 4 + 8 = 40$ in.

"CONJUGATES" AND "EXTRA FOCAL" DISTANCES

The full distances: (1) lens to plate, and (2) lens to original, are called the "conjugate focal lengths."

Imagine a solid bar projecting in front of and behind the lens to a distance in each case equal to the focal length of the lens. The

distances from opposite ends of the imaginary bar to the original and plate respectively are the "extra focal distances" (E.F.D.). They are the conjugates less one focal length.

MENTAL LENS CALCULATIONS.

By using the "extra focal distances" lens calculations become much more readily done in the head, remembering that:—

When copying or enlarging, say, 4 times, the greater "extra focal distance" is four times the focal length of the lens, and the smaller "extra focal distance" one fourth the focal length of the lens. Similarly for a 5-times reduction or enlargement, the greater E.F.D. is five times the focal length; the smaller, one-fifth the focal length.

By adding one focal length to each of these E.F.D.'s we get the actual distances from plate and original to lens.

STUDIO CALCULATIONS.

(By the E.F.D. Method.)

To calculate what length of studio is necessary for work of a given kind with a given lens, it is convenient to take the height of the average sitter as:—

Full length standing	68 inches
Head and shoulders	30 inches

When making portraits in the sizes of prints in common use, the degrees of reduction are those given in the following table:—

Name and Size of Photograph.	6½ in.	Cabinet	Boudoir	Imperial
Height of image on photograph	3	5	7½	9
For full-length portrait, reduction figure is	23	13	9	7½
For head and shoulders portrait, reduction figure is	10	6	4	3 nearly

$$* 8\frac{1}{2} \times 5. \quad + 10 \times 6\frac{1}{2}.$$

These few figures and the E.F.D. rule given above are all that is required for the ordinary studio calculations.

Thus we want to know what descriptions of work can be done, say, in a studio 18 ft. long with a 10 in. lens, that is we want to find the reduction figure possible in these conditions.

In all calculations of studio working space 6 ft. ought to be subtracted from the wall-to-wall length. The sitter will usually be 3 ft. in front of the back wall, and the photographer wants about the same space behind the camera.

Therefore, working space is 12 ft. = 144 in.

Subtracting 2 focal lengths (20 inches), the space for the two E.F.D.'s is 124 ins. As the smaller E.F.D. is only an inch or so (a fraction of the focal length), it is near enough to take this 124 ins. as the front E.F.D. Dividing it by the focal length,

$$124 \div 10 = 12\frac{1}{2},$$

we get the reduction figure, showing that the greatest reduction we can get is not quite enough for full length cabinets.

Similar studio calculations are readily made, bearing in mind that the total wall-to-wall length is parcelled out thus -

E.F.D. towards object (large).

E.F.D. towards image (small).

Two focal lengths.

Space for sitter and operator (6 ft.).

Remember, too, that the object E.F.D. is equal to the focal length \times the reduction figure, whilst the image E.F.D. is the focal length \div the reduction figure, and is, therefore, never more than an inch or two at the most.

SHORTENING AND INCREASING THE FOCAL LENGTH OF A LENS

The rule (very rough, on account of the impossibility of knowing from which part of a lens-mount to measure) for finding the focal length of an extra lens, to reduce or increase the focal length of a given lens, is:-

Multiply the focal length to be altered by the final focal length desired, and divide the product by the original focal length less the final focal length.

$$\text{That is: } f_2 = \frac{f_1 \times F}{f_1 - F}$$

where f_1 is the original focal length,

F the final focal length required,

and f_2 the focal length of the necessary added lens.

- To increase the focal length use a negative lens.

To reduce the focal length use a positive lens.

MAGNIFIERS.

When using a supplementary lens (magnifier) as a means of bringing near objects into focus, the focal length of the supplementary lens must be equal to the distance of the object. This holds good whatever the focal length of the original lens.

TELEPHOTO CALCULATIONS.

F = equivalent focal length of complete lens.

f_1 = equivalent focal length of positive.

f_2 = equivalent focal length of negative.

E = camera extension, from negative lens to ground glass.

M = magnification, that is number of times the image given by the complete lens is larger than that given by positive alone.

Magnification when working at given extension is found by dividing camera extension by focal length of negative lens and adding 1.

$$M = \frac{E}{f_2} + 1.$$

Camera extension, necessary for given magnification—multiply focal length of negative lens by magnification less 1.

$$E = f_2 (M - 1)$$

Focal length of complete lens.—Multiply focal length of positive by magnification.

STEREOSCOPIO FACTS AND FIGURES

To secure correct conditions of convergency each print must be seen under the same angle of view as that at which it was produced, and the two prints must be mounted in accord with the following rules:—

Let P = separation of any pair of corresponding points on prints

N = separation of same points on negatives.

E = separation of eyes (average is 64 mm.).

L = separation of camera lenses

A non-prismatic stereoscope being used —

1. If image points represent infinitely distant objects, make $P = E$.

2. If only near objects are shown and an ordinary single plate double lens stereo camera has been used

Make $P = E + L - N$.

3. If a single camera is used for two separate exposures, or if two separate similar cameras are used together, measure N with negatives placed edge to edge and in the same relative positions that they occupied during exposure, and then

Make $P = E - N + \text{length of one plate.}$

If a prismatic stereoscope, fitted with properly centred half lenses is used, add the width of one prism to above values of P

DIAPHRAGM NUMBERS.

EQUIVALENT $F/$ AND UNIFORM SYSTEM NUMBERS.

Rel. Exposure R-q'd.	1	2	4	8	16	32	64	128
F No.	4	5.6	8	11.3	16	22.6	32	45.2
U.S. Nos.	1	2	4	8	16	32	64	128

NOTE.—Most lenses are now marked with the $f/$ numbers, although the U.S. numbers are used on Kodak lenses. Also the actual diameter of the diaphragm aperture in millimetres is marked on Zeiss lenses, such as the "Convertible."

APPROXIMATE INFINITY FOR LENSES OF VARIOUS FOCAL LENGTHS.

By C. WELBORNE PIPEL, from "The First Book of the Lens."

FOCAL LENGTH, INCHES	DISTANCE OF FOCUSING SCREEN BEHIND PRINCIPAL FOCUS.			
	$\frac{1}{100}$ in.	$\frac{1}{200}$ in.	$\frac{1}{300}$ in.	$\frac{1}{400}$ in.
1	3 yds	7½ yds	15 yds	30 yds
2	11	28	55	110
3	25	63	125	250
4	45	113	225	450
5	70	175	350	700
6	100	250	500	1000
7	136	340	680	1360
8	178	½ mile	½ mile	1 mile
9½	264	660 yds	½ "	1½ miles
11½	351	½ mile	1 "	2 "
12½	434	1085 yds	1½ miles	2½ "
13½	525	½ mile	1½ "	3 "
16	700	1 "	2 "	4 "
17½	875	1½ miles	2½ "	5 "
19½	1056	1½ "	3 "	6 "
21	1225	1½ "	3½ "	7 "
22½	1406	2 "	4 "	8 "
24	1600	2½ "	4½ "	9 "
25	1 mile	2½ "	5 "	10 "
28	1½ miles	3½ "	6½ "	13 "
30	1½ "	3½ "	7½ "	15 "
33	1½ "	4½ "	9 "	18 "
35	2 "	5 "	10 "	20 "

By focussing accurately on distances not less than those given, we ensure that the focussing-screen is within $\frac{1}{100}$, $\frac{1}{200}$, $\frac{1}{300}$, or, $\frac{1}{400}$ in. from the true principal focus.

DISTANCES WHEN ENLARGING AND REDUCING.

Focus of Lens, inches	TIMES OF ENLARGEMENT AND REDUCTION.							
	1	2	3	4	5	6	7	8
3	6 6	9 4½	12 4	15 3¾	18 3¾	21 3½	24 3¾	27 3¾
3½	7 7	10½ 5½	14 4¾	17½ 4¾	21 4½	24½ 4½	28 4	31½ 3½
4	8 8	12 6	16 5½	20 5	24 4½	28 4¾	32 4½	36 4½
4½	9 9	13½ 6½	18 6	22½ 5½	27 5½	31½ 5½	36 5½	40½ 5½
5	10 10	15 7½	20 6½	25 6½	30 6	35 5¾	40 5¾	45 5½
5½	11 11	16½ 8½	22 7½	27½ 6¾	33 6¾	38½ 6½	44 6¾	49½ 6¾
6	12 12	18 9	24 8	30 7½	36 7½	42 7	48 6¾	54 6¾
7	14 14	21 10½	28 9½	35 8¾	42 8½	49 8½	56 8	63 7½
8	16 16	24 12	32 10½	40 10	48 9¾	56 9½	64 9½	72 9
9	18 18	27 13½	36 12	45 11½	54 10¾	63 10½	72 10¾	81 10½
10	20 20	30 15	40 13½	50 12½	60 12	70 11½	80 11¾	90 11½
11	22 22	33 16½	44 14¾	55 13¾	66 13½	77 12¾	88 12¾	99 12¾
12	24 24	36 18	48 16	60 15	72 14½	84 14	96 13¾	108 13½

The table is used as follows:—Knowing the focal length of the lens to be used and the degree of (linear) enlargement or reduction, look up the figure for enlargement or reduction in the upper horizontal row, and carry the eye down the column below it until it reaches the horizontal line of figures opposite the focal length of lens in the left-hand column.

When *enlarging*, the greater of the two distances where the two lines join is the distance from lens to the sensitive paper or plate. The lesser is the distance from lens to negative, or picture being enlarged direct in camera.

When *reducing*, the distances are *vice-versa*: the greater is the distance from lens to original, the smaller from lens to sensitive plate.

RELATIVE EXPOSURES WHEN ENLARGING (WITHOUT A CONDENSER)

New Times of Enlarge- ment	Time of enlargement for which exposure is known											
	1	1	2	2½	3	3½	4	5	6	8	10	12
1	1	1	2	2½	3	3½	4	5	6	8	10	12
1½	1½	1	1½	1½	1	1	1	1	1½	1½	1	1
2	2	1½	1	1	1	1	1	1	1	1	1	1
2½	3	2	1½	1	1	1	1	1	1	1	1	1
3	4	2½	1½	1½	1	1	1	1	1	1	1	1
3½	5	3	2½	1½	1½	1	1	1	1	1	1	1
4	6	4	3	2	1½	1½	1	1	1	1	1	1
5	9	6	4	3	2	1½	1½	1	1	1	1	1
6	12	8	5	4	3	2½	2	1½	1	1	1	1
8	20	13	9	7	5	4	3½	2½	1½	1	1	1
10	30	19	13	10	7	6	5	3½	2½	1½	1	1
12	42	27	19	14	11	8	7	4½	3½	2	1½	1

To use this table find in the top horizontal line the number of times of enlargement for which exposure is known. Under this number the relative time of exposure for different degrees of enlargement will be found opposite the new times of enlargement in the first vertical column.

RELATIVE EXPOSURES WHEN COPYING OR REDUCING

New Scale of Reduction	Scale of reduction for which exposure is known											
	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1½	1½	1½	2½	2½	3	3	3	3½	3½	3½
1½	1	1	1½	1½	1½	2	2	2½	2½	2½	3	3
2	1	1	1	1½	1½	1½	2	2	2½	2½	2½	3
2½	1	1	1	1	1½	1½	1½	1½	2	2	2	2
3	1	1	1	1	1	1½	1½	1½	1½	1½	1½	1½
3½	1	1	1	1	1	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1	1	1	1	1	1
5	1	1	1	1	1	1	1	1	1	1	1	1
6	1	1	1	1	1	1	1	1	1	1	1	1
7	1	1	1	1	1	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1	1	1	1	1	1
12	1	1	1	1	1	1	1	1	1	1	1	1

To use this table find in the top horizontal line the scale of reduction for which exposure is known. Under this scale the relative time of exposure for different degrees of reduction will be found opposite the new scales of reduction marked in first vertical column.

TABLE OF VIEW-ANGLES.

DIVIDE THE BASE* OF THE PLATE BY THE EQUIVALENT FOCUS OF THE LENS.

If the quotient is	The angle is	If the quotient is	The angle is	If the quotient is	The angle is
	Degrees		Degrees		Degrees
0 282	16	0 748	41	1 3	66
0 3	17	0 768	42	1 32	67
0 317	18	0 788	43	1 36	68
0 335	19	0 808	44	1 375	69
0 353	20	0 828	45	1 4	70
0 37	21	0 849	46	1 427	71
0 389	22	0 87	47	1 45	72
0 407	23	0 89	48	1 48	73
0 425	24	0 911	49	1 5	74
0 443	25	0 933	50	1 53	75
0 462	26	0 954	51	1 56	76
0 48	27	0 975	52	1 59	77
0 5	28	1 0	53	1 62	78
0 517	29	1 02	54	1 649	79
0 536	30	1 041	55	1 678	80
0 555	31	1 063	56	1 7	81
0 573	32	1 086	57	1 739	82
0 592	33	1 108	58	1 769	83
0 611	34	1 132	59	1 8	84
0 631	35	1 155	60	1 833	85
0 65	36	1 178	61	1 865	86
0 67	37	1 2	62	1 898	87
0 689	38	1 225	63	1 931	88
0 708	39	1 25	64	1 965	89
0 728	40	1 274	65	2 0	90

Example — Given a lens of 13 inches equivalent focus, required the angle included by it on plate $3\frac{1}{2} \times 4\frac{1}{2}$.

Diagonal is 5.3 inches $5.3 \div 13 = .407$, corresponding with angle of 23° .

* More accurately the diagonal of the plate, inasmuch as the field of the lens is circular, and if the corners of the plate are to be covered the angle embraced by the lens should be sufficient to cover the diagonal of the plate. The maker of a lens, stated to cover up to a given angle, may be asked if that angle is measured on the length or diagonal of a plate.

The lengths of the diagonals of the plates most commonly used are

$3\frac{1}{2} \times 3\frac{1}{2}$	diagonal 4.6 inches	$7\frac{1}{2} \times 5$	diagonal 9.0 inches.
$3\frac{1}{2} \times 4\frac{1}{2}$	" 5.3 "	$6\frac{1}{2} \times 8\frac{1}{2}$	" 10.7 "
5×4	" 5.4 "	10×8	" 12.8 "
$4\frac{1}{2} \times 6\frac{1}{2}$	" 8.0 "	12×10	" 15.6 "
7×6	" 8.6 "	15×12	" 19.2 "

E. M. NELSON'S TABLE OF DISTANCES FOR LANTERN PROJECTION.
DISTANCE OF PROJECTION LENS FROM SCREEN, MASK BEING THREE INCHES.

Feet	4 1/2	5	5 1/2	6	7	8	9	10	11	12	14	15	16	18
Dist.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
5	7 10 1/2	8 9	9 7 1/2	10 6	12 3	14 0	15 9	17 6	19 3	21	24 6	26 3	28 0	31 6
6	9 4 1/2	10 5	11 5 1/2	12 6	14 7	16 8	18 9	20 10	22 11	25	29 2	31 3	33 4	37 6
7	10 10 1/2	12 1	13 3 1/2	14 6	16 11	19 4	21 9	24 2	26 7	29	33 10	36 3	38 8	43 6
8	12 4 1/2	13 9	15 1 1/2	16 6	19 3	22 0	24 9	27 6	30 3	33	38 6	41 3	44 0	49 6
9	13 10 1/2	15 5	16 11 1/2	18 6	21 7	24 8	27 9	30 10	33 11	37	43 2	46 3	49 4	55 6
10	15 4 1/2	17 1	18 9 1/2	20 6	23 11	27 4	30 9	34 2	37 7	41	47 10	51 3	54 8	61 6
11	16 10 1/2	18 9	20 7 1/2	22 6	26 3	30 0	33 9	37 6	41 3	45	52 6	56 3	60 0	67 6
12	18 4 1/2	20 5	22 5 1/2	24 6	28 7	32 8	36 9	40 10	44 11	49	57 2	61 3	65 4	73 6
13	19 10 1/2	22 1	24 3 1/2	26 6	30 11	35 4	39 9	44 2	48 7	53	61 10	66 3	70 8	79 6
14	21 4 1/2	23 9	26 1 1/2	28 6	33 3	38 0	42 9	47 6	52 3	57	66 6	71 3	76 0	85 6
15	22 10 1/2	25 5	27 11 1/2	30 6	35 7	40 8	45 9	50 10	55 11	61	71 2	76 3	81 4	91 6
16	24 4 1/2	27 1	29 9 1/2	32 6	37 11	43 4	48 9	54 2	59 7	65	75 10	81 3	86 8	97 6
18	27 4 1/2	30 5	33 5 1/2	36 6	42 7	48 8	54 9	60 10	66 11	73	85 2	91 3	97 4	109 6
20	30 4 1/2	33 9	37 1 1/2	40 6	47 3	54 0	60 9	67 6	74 3	81	94 6	101 3	108 0	121 6
25	37 10 1/2	42 1	46 3 1/2	50 6	58 11	67 4	75 9	84 2	92 7	101	117 10	126 3	134 8	151 6
30	45 4 1/2	50 5	56 5 1/2	60 6	70 7	80 8	90 9	100 10	110 11	121	141 2	151 3	161 4	181 6
35	53 10 1/2	58 9	64 7 1/2	70 6	82 3	94 0	105 9	117 6	129 3	141	164 6	176 3	188 0	211 6
40	60 4 1/2	67 1	73 9 1/2	80 6	93 11	107 4	120 9	134 2	147 7	161	187 10	201 3	214 8	241 6
45	67 10 1/2	75 5	82 11 1/2	90 6	105 5	120 8	135 9	150 10	165 11	181	211 2	226 3	241 4	271 6
50	75 4 1/2	83 9	92 1 1/2	100 6	117 3	134 0	150 9	167 6	184 3	201	234 6	251 3	268 0	301 6

**TABLES OF DISTANCES AT AND BEYOND WHICH ALL
OBJECTS ARE IN FOCUS WHEN SHARP FOCUS IS
SECURED ON INFINITY.**

Focal length of Lens in inches	Ratio marked on Stop.															
	f/4	f/5.6	f/8	f/11	f/16	f/22	f/32	f/45	f/64	f/90	f/126	f/180	f/252	f/360	f/504	f/720
	Number of feet at which all is in focus															
4	35	21	14	10	7	5	4	3	2	1	1	1	1	1	1	1
4½	38	24	16	11	8	5	4	3	2	1	1	1	1	1	1	1
4¾	42	26	18	12	9	6	4	3	2	1	1	1	1	1	1	1
4¾	44	28	19	13	10	7	5	4	3	2	1	1	1	1	1	1
5	47	30	20	14	11	8	5	4	3	2	1	1	1	1	1	1
5½	52	34	23	16	12	9	6	4	3	2	1	1	1	1	1	1
6	56	37	25	18	13	10	7	5	4	3	2	1	1	1	1	1
6½	61	40	28	20	14	11	8	5	4	3	2	1	1	1	1	1
7	65	43	30	22	15	12	9	6	4	3	2	1	1	1	1	1
7½	70	46	33	24	17	13	10	7	5	4	3	2	1	1	1	1
8	75	49	36	26	18	14	11	8	5	4	3	2	1	1	1	1
8½	80	52	39	28	20	15	12	9	6	4	3	2	1	1	1	1
9	85	55	42	30	22	16	13	10	7	5	4	3	2	1	1	1
9½	90	58	45	32	24	18	14	11	8	5	4	3	2	1	1	1
10	95	61	48	34	26	20	15	12	9	6	4	3	2	1	1	1
10½	100	64	51	36	28	22	17	13	10	7	5	4	3	2	1	1
11	105	67	54	38	30	24	18	14	11	8	5	4	3	2	1	1
11½	110	70	57	40	32	26	20	15	12	9	6	4	3	2	1	1
12	115	73	60	42	34	28	22	17	13	10	7	5	4	3	2	1
12½	120	76	63	44	36	30	24	18	14	11	8	5	4	3	2	1
13	125	79	66	46	38	32	26	20	15	12	9	6	4	3	2	1
13½	130	82	69	48	40	34	28	22	17	13	10	7	5	4	3	2
14	135	85	72	50	42	36	30	24	18	14	11	8	5	4	3	2
14½	140	88	75	52	44	38	32	26	20	15	12	9	6	4	3	2
15	145	91	78	54	46	40	34	28	22	17	13	10	7	5	4	3
15½	150	94	81	56	48	42	36	30	24	18	14	11	8	5	4	3
16	155	97	84	58	50	44	38	32	26	20	15	12	9	6	4	3
16½	160	100	87	60	52	46	40	34	28	22	17	13	10	7	5	4
17	165	103	90	62	54	48	42	36	30	24	18	14	11	8	5	4
17½	170	106	93	64	56	50	44	38	32	26	20	15	12	9	6	4
18	175	109	96	66	58	52	46	40	34	28	22	17	13	10	7	5
18½	180	112	99	68	60	54	48	42	36	30	24	18	14	11	8	5
19	185	115	102	70	62	56	50	44	38	32	26	20	15	12	9	6
19½	190	118	105	72	64	58	52	46	40	34	28	22	17	13	10	7
20	195	121	108	74	66	60	54	48	42	36	30	24	18	14	11	8
20½	200	124	111	76	68	62	56	50	44	38	32	26	20	15	12	9
21	205	127	114	78	70	64	58	52	46	40	34	28	22	17	13	10
21½	210	130	117	80	72	66	60	54	48	42	36	30	24	18	14	11
22	215	133	120	82	74	68	62	56	50	44	38	32	26	20	15	12
22½	220	136	123	84	76	70	64	58	52	46	40	34	28	22	17	13
23	225	139	126	86	78	72	66	60	54	48	42	36	30	24	18	14
23½	230	142	129	88	80	74	68	62	56	50	44	38	32	26	20	15
24	235	145	132	90	82	76	70	64	58	52	46	40	34	28	22	17
24½	240	148	135	92	84	78	72	66	60	54	48	42	36	30	24	18
25	245	151	138	94	86	80	74	68	62	56	50	44	38	32	26	20
25½	250	154	141	96	88	82	76	70	64	58	52	46	40	34	28	22
26	255	157	144	98	90	84	78	72	66	60	54	48	42	36	30	24
26½	260	160	147	100	92	86	80	74	68	62	56	50	44	38	32	26
27	265	163	150	102	94	88	82	76	70	64	58	52	46	40	34	28
27½	270	166	153	104	96	90	84	78	72	66	60	54	48	42	36	30
28	275	169	156	106	98	92	86	80	74	68	62	56	50	44	38	32
28½	280	172	159	108	100	94	88	82	76	70	64	58	52	46	40	34
29	285	175	162	110	102	96	90	84	78	72	66	60	54	48	42	36
29½	290	178	165	112	104	98	92	86	80	74	68	62	56	50	44	38
30	295	181	168	114	106	100	94	88	82	76	70	64	58	52	46	40
30½	300	184	171	116	108	102	96	90	84	78	72	66	60	54	48	42
31	305	187	174	118	110	104	98	92	86	80	74	68	62	56	50	44
31½	310	190	177	120	112	106	100	94	88	82	76	70	64	58	52	46
32	315	193	180	122	114	108	102	96	90	84	78	72	66	60	54	48
32½	320	196	183	124	116	110	104	98	92	86	80	74	68	62	56	50
33	325	199	186	126	118	112	106	100	94	88	82	76	70	64	58	52
33½	330	202	189	128	120	114	108	102	96	90	84	78	72	66	60	54
34	335	205	192	130	122	116	110	104	98	92	86	80	74	68	62	56
34½	340	208	195	132	124	118	112	106	100	94	88	82	76	70	64	58
35	345	211	198	134	126	120	114	108	102	96	90	84	78	72	66	60
35½	350	214	201	136	128	122	116	110	104	98	92	86	80	74	68	62
36	355	217	204	138	130	124	118	112	106	100	94	88	82	76	70	64
36½	360	220	207	140	132	126	120	114	108	102	96	90	84	78	72	66
37	365	223	210	142	134	128	122	116	110	104	98	92	86	80	74	68
37½	370	226	213	144	136	130	124	118	112	106	100	94	88	82	76	70
38	375	229	216	146	138	132	126	120	114	108	102	96	90	84	78	72
38½	380	232	219	148	140	134	128	122	116	110	104	98	92	86	80	74
39	385	235	222	150	142	136	130	124	118	112	106	100	94	88	82	76
39½	390	238	225	152	144	138	132	126	120	114	108	102	96	90	84	78
40	395	241	228	154	146	140	134	128	122	116	110	104	98	92	86	80
40½	400	244	231	156	148	142	136	130	124	118	112	106	100	94	88	82
41	405	247	234	158	150	144	138	132	126	120	114	108	102	96	90	84
41½	410	250	237	160	152	146	140	134	128	122	116	110	104	98	92	86
42	415	253	240	162	154	148	142	136	130	124	118	112	106	100	94	88
42½	420	256	243	164	156	150	144	138	132	126	120	114	108	102	96	90
43	425	259	246	166	158	152	146	140	134	128	122	116	110	104	98	92
43½	430	262	249	168	160	154	148	142	136	130	124	118	112	106	100	94
44	435	265	252	170	162	156	150	144	138	132	126	120	114	108	102	96
44½	440	268	255	172	164	158	152	146	140	134	128	122	116	110	104	98
45	445	271	258	174	166	160	154	148	142	136	130	124	118	112	106	100
45½	450	274	261	176	168	162	156	150	144	138	132	126	120	114	108	102
46	455	277	264	178	170	164	158	152	146	140	134	128	122	116	110	104
46½	460	280	267	180	172	166	160	154	148	142	136	130	124	118	112	106
47	465	283	270	182	174	168	162	156	150	144	138	132	126	120	114	108
47½	470	286	273	184	176	170	164	160	154	148	142	136	130	124	118	112
48	475	289	276	186	178	172	166	162	156	150	144	138	132	126	120	114
48½	480	292	279	188	180	174	168	164	160	154	148	142	136	130	124	118
49	485	295	282	190	182	176	170	166	162	156	150	144	138	132	126	120
49½																

FOCAL LENGTH OF LENSES RECOMMENDED FOR STUDIOS OF VARIOUS LENGTHS.

The following table shows the focus of lens which is suitable for comfortable working in studios of various lengths. In each case it is assumed that 5 ft. of the length will be taken up by camera, operator, sitter and background. The figures in column 1 are the full run of the studio, including this 5 ft. In the case of the short studios the focal lengths are about the longest which can be used in the case of the longer studios somewhat greater focal lengths might be used, but the lenses directed in the table are about the best for general work.

Length of Studio Feet.	C.D.V. half length. Inches.	C.D.V. half length and Cabinet full length Inches.	C.D.V. head, Cabinet half length. Inches.	Cabinet head and Boudoir full length. Inches.	Boudoir half length, Panel full length. Inches.	Boudoir head, Panel half length. Inches.
12	4*	6½*	8½	9*	12*	11
14	4½*	7½*	9	10*	13*	16
16	5*	8½	10	10½	16	18
18	6	8½	10½	10½	16	18
20	6	10	10½	12	18	20
22	7	10½	12	14	22	22
24	8½	12	14	16	24	24
26	8½	13½	16	16	24	24
30	10	13½	16	18	24	24

* Full lengths may be obtained with these focal lengths, but the standpoint is so near to the sitter that good perspective cannot be expected.

TABLE OF DISTANCES FOR AN OBJECT OF SIXTY-EIGHT INCHES HEIGHT.

COMPUTED BY P. BROSG

FOOTING (INCHES)	HEIGHTS OF IMAGES (INCHES)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	130	700	473	360											
3	207	1050	710	540	370										
4	276	1400	949	720	493	300									
5	345	1750	1163	900	617	475	390								
6	414	2100	1420	1080	740	570	408	321							
7	483	2450	1657	1260	863	685	546	427	367						
8	552	2800	1893	1440	987	760	624	533	469	420	352				
9	621	3150	2130	1620	1110	855	702	600	527	472	396				
10	690	3500	2367	1800	1233	980	780	667	587	525	440	383	343		
11	759	3850	2603	1980	1357	1043	858	733	634	577	481	422	377	344	
12	828	4200	2840	2160	1480	1140	936	800	703	630	528	460	411	375	
13	897	4550	3076	2340	1603	1255	1014	867	761	682	572	498	445	405	

1/1000 are omitted here in account
of the small space required.
(More than twenty degrees)

14	986.0	430.0	222.0	172.7	133.0	109.2	92.2	82.0	73.5	61.6	53.7	48.0	43.7	37.8	
16	1104	560.0	376.7	288.0	197.3	152.0	124.8	108.7	93.7	84.0	70.4	61.3	54.9	50.0	43.2
18	1262	630.0	426.0	338.0	272.0	171.0	140.4	120.0	105.1	94.5	79.2	69.0	61.7	56.2	48.6
20	1380	700.0	473.3	380.0	306.7	190.0	156.0	133.3	117.1	105.0	88.0	76.7	68.6	62.5	54.0
22	1518	770.0	520.7	426.0	353.3	209.0	171.6	146.7	128.9	115.5	98.8	84.3	74.4	68.7	59.4
24	1656	840.0	568.0	473.3	390.0	221.3	183.3	156.7	137.1	122.2	103.3	91.1	81.1	75.0	65.8
26	1794	910.0	615.3	517.3	436.7	240.0	202.4	173.3	151.3	135.5	114.4	99.7	89.1	81.2	70.2
28	1932	980.0	662.7	564.0	483.3	258.0	220.0	190.0	166.7	150.0	128.0	112.0	100.0	91.1	80.0
32	2208	1170	770	630	540	300	250	210	180	160	140	120	100	90	80
36	2484	1260	820	680	590	320	270	230	200	180	160	140	120	100	90
44	3036	1560	1020	840	720	400	340	290	250	220	200	180	160	140	120
52	3588	1860	1220	1000	880	460	400	350	310	280	260	240	220	200	180

This table gives, in inches, the distances from lens to object (greater or smaller) for the upper number, and from lens to ground glass (greater or smaller) for the lower number, for different heights of images and different lengths of focal lenses, when the height of object is 56 inches — average height of man.

EXAMPLES.

- Q.—What is the height of image of a person who is 135 inches distance from lens, when a lens of 14 inches focus is used?
 A.—The height of image in this case is 8 inches.
 Q.—What are the distances between object, lens, and ground glass if the image of a person is to be 8 inches high and a 14 inches focus lens is employed?
 A.—The distance from object to lens will be 133 inches, and from lens to ground glass 156 inches.

TABLES IN PAST ISSUES OF THE ALMANAC.

The following is a list of tables which have appeared in past issues of the "Almanac," but are not included among those in the present volume.

The reference in brackets after each is to the most recent issue of the "Almanac" in which the table has appeared; in most cases it will be found included for several years prior to the date of this reference.

CHEMICAL TABLES.

- Weights and Measures Act.* ["B.J.A." 1905, p. 1012.]
Simplification of Emulsion Calculations. (*Equivalence of Alkaline Haloid Salts.*) ["B.J.A." 1908, p. 1180.]
Solubility of the Silver Haloids—Valenta ["B.J.A." 1907, p. 1109.]
Freezing Mixtures. ["B.J.A." 1907, p. 1116.]
Chemical Equivalence of the Alkalies. ["B.J.A." 1903, p. 1159.]
Developing Equivalence of the Alkalies. ["B.J.A." 1903, p. 1159.]
Chemical Reactions of the known Developing Agents (Tests of Developers). ["B.J.A." 1904, p. 1010.]
Pyro Developers recommended for various Plates by Makers ["B.J.A." 1900, p. 666.]
Tables of Developers (in grains per oz.) for Various Commercial Plates ["B.J.A." 1912, p. 761.]

ORTHOCHROMATIC DATA.

- Speeds and Colour Sensitiveness of Various Plates to Different Lights.* —Eder. ["B.J.A." 1907, p. 1115.]
Wave-Lengths of the Principal Fraunhofer Spectrum Lines, and the Elements that give them ["B.J.A." 1905, p. 1144.]
Reflection of Light from various surfaces. ["B.J.A." 1900, p. 1016.]

LIGHT AND EXPOSURE.

- Hourly Variation in the Sun's Position in Degrees from the South at Different Seasons of the Year.* —J. A. C. Bransfil. ["B.J.A." 1903, p. 1176.]
Points of the Compass at which the Sun rises for London, Edinburgh, and Dublin. ["B.J.A." 1869, p. 147.]
Sun's Altitude for various Latitudes. ["B.J.A." 1898, p. 1063.]
Exposure and Lens Aperture. ["B.J.A." 1910, p. 893.]
Actinograph Exposure Table. ["B.J.A." 1901, p. 702.]
Comparative Exposures. —W. K. Burton. ["B.J.A." 1887, p. 341.]
Comparative Exposures. —Dr. Scott. ["B.J.A." 1887, p. 432.]
Displacement on Ground Glass of Objects in Motion. ["B.J.A." 1903, p. 1180.]
Comparative Plate-speed Numbers. ["B.J.A." 1912, p. 897.]

OPTICAL TABLES.

- Equations relating to Foci, etc.* —Bransfil. ["B.J.A." 1907, p. 1120.]
Depth of Field.—Formulae. ["B.J.A." 1910, p. 894.]
Combining Lenses.—Formulae. ["B.J.A." 1910, p. 898.]
Perspective—Factors. ["B.J.A." 1910, p. 895.]
Correction of Convergent Distortion.—Formulae. ["B.J.A." 1910, p. 896.]
Scale of Image.—Formulae. ["B.J.A." 1910, p. 893.]
Conjugate Foci.—Formulae. ["B.J.A." 1910, p. 892.]
Minimum Length of Studio for a given Lens. ["B.J.A." 1906, p. 998.]
Royal Photographic Society's Standard Diaphragms. ["B.J.A." 1903, p. 1178; 1905, p. 1149; and 1907, p. 1093.]
"Uniform System" Numbers for Stops from $f/1$ to $f/100$. ["B.J.A." 1905, p. 1147.]
Continental Stops and their U.S. Equivalents. ["B.J.A." 1907, p. 1127.]
Correction for Inconstancy of Aperture—Formulae. ["B.J.A." 1910, p. 895.]
Angles and Foci of the Telephoto Lens. ["B.J.A." 1894, p. 949.]
Steinheil's Table of Camera Extensions, Equivalent Foci and Diameters of Images corresponding to a given Magnification of the Telephoto-graphic Lens. ["B.J.A." 1902, p. 793.]
Focusing with Pinhole Apertures. ["B.J.A." 1896, p. 964.]

